

WEST VIRGINIA
GEOLOGICAL SURVEY





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PLATE I.—Falls of Wolf Creek, one mile west of Aurora, over upper ledge of Torono, or Big Injun Oil Sand. Photo by E. E. Knight

WEST VIRGINIA GEOLOGICAL SURVEY



Preston County

By

RAY V. HENNEN, Assistant Geologist

and

DAVID B. REGER, Assistant Geologist

Part IV—Paleontology, by W. ARMSTRONG PRICE
Paleontologist.

I. C. WHITE, State Geologist.



WHEELING NEWS LITHO. CO.
WHEELING, W. VA.
1914

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W. ARMSTRONG PRICE.....*Paleontologist*

ROBERT M. GAWTHROP.....*Field Assistant*

D. D. TEETS, JR.....*Field Assistant*

BERT H. HITE.....*Chief Chemist*

JAN B. KRAK.....*Assistant Chemist*

J. LEWIS WILLIAMS.....*Chief Clerk*

RIETZ C. TUCKER.....*Stenographer*

LETTER OF TRANSMITTAL.

To His Excellency, Hon. Henry D. Hatfield, Governor of West Virginia, and President of the West Virginia Geological Survey Commission:

Sir:

I have the honor to transmit herewith the Detailed Report and Maps covering the area of Preston County, prepared by Assistants Ray V. Hennen and David B. Reger.

The volume in question contains an immense fund of information concerning the natural resources of this great county, collected and marshalled into systematic and readable form by these two skillful geologists of the Survey Staff. The part that each performed is told by themselves in the Authors' Preface.

The Topographic Map of Preston reveals for the first time in any publication of general circulation the true line separating this county from Garrett county, Maryland, as finally determined and adjudicated by the United States Supreme Court from the surveys undertaken and concluded by the Commissioners it appointed. Through this decision, several square miles of good land were permanently added to the area of the State as well as to Preston County, and the matter, which had been in controversy between the two States, definitely adjudicated for all time. The Report of this Survey Commission as well as the judicial decision of the highest Court in the Union affirming the same is published in this volume on pages 2 to 24, inclusive, and the north and south line separating West Virginia from Maryland, along the Preston-Garrett county boundary corrected to conform to the decision in question, is shown not only on the topographic map of Preston, but also on the geologic and economic map of the same. The accompanying soil map of Preston does not show this revised boundary line because it was prepared by the U. S

Bureau of Soils before the decision of the U. S. Supreme Court was available in printed form, and hence it exhibits the disputed area formerly claimed by Maryland. The line as finally determined is not a straight one, but has several jogs in the same, all of which, as also the location of the monuments which were set to mark off the actual line on the ground, are shown on the topographic map of Preston herein enclosed in the case of maps and marked as Map I.

I. C. WHITE, *State Geologist.*

Morgantown, W. Va., September 1st, 1914.

CONTENTS.

	Page
Members of Geological Survey Commission and State Board of Control	III
Members of Scientific Staff.....	V
Letter of Transmittal.....	VI
Table of Contents.....	VII
Author's Preface.....	XVI

PART I. HISTORY AND PHYSIOGRAPHY.

Chapter I.—Historical and Industrial Development.....	1-43
Location	1-25
Transportation	25-31
Water Ways.....	25-26
Cheat River.....	25-26
Steam Railroads.....	26-28
Baltimore & Ohio Railroad.....	26-27
Morgantown & Kingwood Railroad.....	27
West Virginia Northern Railroad.....	27
Kendall Lumber Co. Railroad.....	27
Rowlesburg & Southern R. R.....	27-28
Lumber Railroads.....	28
Highways	28-31
Indian Trails.....	28-29
Northwestern Virginia Turnpike.....	29
Brandonville & Fishing Creek Turnpike.....	29-30
Morgantown & Kingwood Turnpike.....	30
Morgantown & Beverly Turnpike.....	30
Tunnelton & Ices Ferry Turnpike.....	30
Kingwood & Brandonville Turnpike.....	30-31
Kingwood & Terra Alta Turnpike.....	31
Aurora & Terra Alta Turnpike.....	31
Ordinary County Roads.....	31
General Description.....	31-43
Miscellaneous Items.....	31-34
Area	31
Relief	32
Population	32-33
Products	33
Property Valuation.....	33
Postal Service.....	33-34
Towns and Industries.....	34-43
Chapter II.—Physiography.....	44-54
Physiographic Changes.....	44-49
Drainage Basins.....	49-52
Topographic Features.....	52-54

PART II. GEOLOGY.

Chapter III.—Structure.....	55-74
Description of Terms.....	55-56

	Page
Methods of Representing Structure.....	56-59
Structure Contours.....	56-59
Cross Sections.....	59
Detailed Structure.....	60-74
Anticlines	60-66
Synclines	66-72
Unconformities	73-74
Faults	73-74
Chapter IV.—Stratigraphy—General Sections.....	75-105
Introduction	75-76
Grant District.....	76-82
Pleasant District.....	82-86
Valley District.....	86-88
Lyon District.....	88-92
Kingwood District.....	92-94
Portland District.....	94-96
Reno District.....	96-101
Union District.....	101-103
Summary	104-105
Chapter V.—Stratigraphy—The Monongahela Series.....	106-111
General Account and Section.....	106-107
Description of Formations.....	107-111
Chapter VI.—Stratigraphy—The Conemaugh Series.....	112-150
General Account and Section.....	112-114
Local Sections.....	114-117
Description of Formations.....	117-150
Chapter VII.—Stratigraphy—The Allegheny Series.....	151-176
General Account and Section.....	151-152
Local Section.....	152-153
Description of Formations.....	153-176
Chapter VIII.—Stratigraphy—The Pottsville Series.....	177-184
General Account and Section.....	177-178
Description of Formations.....	178-184
Chapter IX.—Stratigraphy—The Mississippian Rocks.....	185-188
Mauch Chunk Series.....	185-186
Greenbrier Limestone.....	186-187
Pocono Sandstones.....	187-188
Chapter X.—Stratigraphy—The Devonian Rocks.....	189-195
Catskill Series.....	189-191
General Account.....	189
Local Features.....	189-190
Absence of Fossils.....	190-191
Chemung Series.....	191-195
General Account.....	191-192
Local Features.....	192-194
Plant and Marine Life.....	194-195

PART III. MINERAL RESOURCES.

Chapter XI.—Petroleum and Natural Gas.....	196-215
Oil and Gas Horizons.....	197-198
Well Records and Prospective Areas.....	199-215
Summarized Records.....	200
Grant District.....	201-203
Pleasant District.....	203-206
Valley District.....	206-207

	Page
Lyon District.....	207-209
Kingwood District.....	209
Reno District.....	209-211
Portland District.....	211-214
Union District.....	214-215
Chapter XII.—Coal.....	216-370
Statistics of Coal Production.....	216-218
Diamond Drill Borings.....	219-260
Table of, Summarized.....	220-221
Detailed Records of.....	222-260
Grant District.....	222
Pleasant District.....	222-228
Valley District.....	228-239
Lyon District.....	240-245
Kingwood District.....	245-250
Reno District.....	251-258
Portland District.....	258
Union District.....	258-260
Mineable Coals.....	260-363
Coals of the Monongahela Series.....	263-265
Pittsburgh Coal.....	263-265
Coals of the Conemaugh Series.....	265-268
Elk Lick Coal.....	265-266
Harlem Coal.....	266
Bakerstown Coal.....	266-268
Coals of the Allegheny Series.....	268-357
Upper Freeport Coal.....	268-311
Coke from.....	310-311
Lower Freeport Coal.....	312
Upper Kittanning Coal.....	312-324
Lower Kittanning Coal.....	324-348
Clarion Coal.....	348-357
Coals of the Pottsville Series.....	358
Quakertown Coal.....	358
Absence of Coal in the Mississippian and Devonian Rocks..	358
Summary of Available Coal.....	360
Mineable Coals by Magisterial Districts.....	360-363
Grant District.....	361
Pleasant District.....	361
Valley District.....	361
Lyon District.....	362
Reno District.....	362
Kingwood District.....	362
Portland District.....	363
Union District.....	362
Table of Coal Analyses.....	363-367
Page Reference to Description of Coal Mines.....	368-370
Chapter XIII.—Clays, Limestones and Road Material.....	371-390
Clay	371-378
Absence of Development.....	371
Available Clay.....	371-378
Transported Clays.....	371-372
Shale	372-373
Fire Clay.....	373-378
Limestone	378-388
Present Development.....	379-388

	Page
Limestone Quarries.....	379-385
Cement Mills.....	385-388
Available Limestone.....	388
Road Material	388-390
Limestone	388-389
Sandstone	389
River and Creek Gravel.....	389
Brick for Road Pavement.....	390
Chapter XIV.—Building Stone, Glass Sand, Iron Ore, Water	
Power, Mineral Water, and Forests.....	391-424
Building Stone.....	391-400
Quarries	391-400
Glass Sand.....	400-405
Quarries	400-403
Available Sand.....	403-405
Iron Ore.....	405-412
Old Furnaces.....	405-406
Available Ore.....	407-412
Water Power Resources.....	412-418
Present Development.....	412
Available Power.....	413-418
Mineral Waters.....	418-422
Medicinal Springs.....	419-422
Forests	422-424
Original Forest Conditions.....	422
Lumber Industry.....	423
Present Forest Conditions.....	423-424
Areas Suitable for Reforestation.....	424
Chapter XV.—Soil Survey.....	425-469
Climatological Data.....	425-428
Climate	429-431
Agriculture	432-439
Soils	439-466
Summary	466-469
Chapter XVI.—Levels Above Mean Tide.....	470-471
Baltimore and Ohio Railroad.....	470
Morgantown and Kingwood Railroad.....	471

PART IV. PALEONTOLOGY.

Chapter XVII.—Notes on the Paleontology of Preston County..	472-553
Introduction	472-3
Faunal Horizons of the Conemaugh Series.....	473-487
Ames Limestone.....	474-6
Albright Limestone.....	476-7
Pine Creek Limestone.....	477
Brush Creek Limestone.....	477
Distribution of Fossils, Tables Showing.....	479-482
The Corinth Basin.....	482-5
Register of Localities.....	485-7
Description of Species.....	488-547
Description of Plate XLII.....	548-9
Description of Plate XLIII.....	550-1
Index to Species.....	552-3
Index	554-566

ILLUSTRATIONS.

Maps in Atlas (under separate cover).

- Map I.—Topographic Map of the Preston County Area.
 Map II.—Map Showing Economic Geology and Structure Contours of
 the Upper Freeport Coal and Five Cross Sections.
 Map III.—Soil Map of the Preston County Area.

No.	Plates.	Facing Page
I.—Falls of Wolf Creek, 1 Mile West of Aurora—Over Upper Ledge of Pocono.....		Frontispiece
II.—Type of Concrete Monuments Marking the Final Determina- tion of the West Virginia-Maryland State Line.....		8
III.—State Tuberculosis Sanitarium.....		36
IV(a).—Bruceton Mills, Showing Topography of Allegheny Series in Foreground and Conemaugh in Background.....		52
IV(b).—Big Sandy Creek at Bruceton Mills Dam.....		52
V.—View of Kingwood Looking East. Briery Mountain in Back- ground		64
VI.—View of Terra Alta Looking Northwest—Topography Princi- pally in Catskill Series.....		80
VII.—View of Rowlesburg Looking West, Showing Topography of Chemung, Catskill and Pocono Rocks.....		96
VIII.—Village of Eglon Looking East, Showing Topography of Catskill Series in Foreground and Pottsville Series in Back- bone Mountain in Background.....		112
IX.—Showing Uniform Slopes in Topography of the Chemung Series, Looking South Down Horseshoe Run from Point 1.8 Miles Southwest of Eglon.....		128
X.—View Looking East Down Rhine Creek, Showing Shaffer Mountain Capped with Pottsville Rocks on Left and Aurora on Right. In the Foreground the Smooth Topography Rep- resents the Junction of the Pocono and Greenbrier Rocks...		144
XI.—Looking North from Kingwood, Showing Topography of the Conemaugh Series and Pottsville Capping Briery Mountain in Extreme Right Background—Plant of Kingwood Quar- ries Company at Right Center.....		160
XII.—Looking East from Masontown, Showing Topography of Conemaugh Series in the Foreground and Pottsville Series on Briery Mountain in Extreme Background.....		176
XIII.—Showing Distortion of the Chemung Strata along B. & O. R. R. Grade West of Terra Alta.....		184

	Facing Page
XIV.—Showing Distorted Condition of the Chemung Rocks in B. & O. R. R. Cut, $1\frac{1}{4}$ Miles Northeast of Rodemer.....	192
XV.—Looking Down Cheat River Gorge from Near Buckhorn on B. & O. R. R. Valley Walls in Mauch Chunk, Pottsville and Allegheny Rocks.....	200
XVI.—Upper Connoquenessing Sandstone in B. & O. R. R. Cut, $2\frac{1}{2}$ Miles Southeast of Tunnelton.....	208
XVII.—Quarry in Upper Portion of Greenbrier Limestone Opposite Manheim; Formerly Operated by B. & O. R. R. Co. for Ballast	216
XVIII.—Shaly Sandstone Member of Pocono Series in B. & O. R. R. Cut South of Manheim.....	224
XIX.—Upper Portion of the Catskill Series in B. & O. R. R. Cut South of Manheim.....	232
XX.—Showing Rapidly Dipping Strata of the Chemung, Catskill, Pocono, Greenbrier and Pottsville Rocks, $\frac{1}{8}$ Mile East of Keyer Run. Heavy Cliff at Left Near Base of Catskill Series	240
XXI.—Falls of Salt Lick Creek, 1 Mile West of Terra Alta and $\frac{1}{8}$ Mile West of the Crest of the Briery Mountain Anticline, Showing Local Syncline and Bedding of Chemung Rocks....	248
XXII.—Local Tilting of Upper Chemung Strata Along B. & O. R. R. Grade Just West of Salt Lick Falls Near Terra Alta. Typical Layers of Hard Thin Sandstones and Soft Shale.....	256
XXIII.—Showing Alternate Layers of Hard Thin Sandstone and Soft Shale of the Chemung in B. & O. R. R. Cut, $\frac{3}{4}$ Mile Northeast of Rodemer.....	264
XXIV.—Showing Ripple Marks and Mud Cracks on Sandstone Flag from Chemung Series near Rowlesburg.....	272
XXV.—Eastern Portals of the Kingwood Tunnels of the B. & O. R. R. at Tunnelton. The Upper Freeport Coal is Shown Cropping at the White Arrows.....	280
XXVI.—View of B. & O. R. R. Cut No. 80 at Blaser, Showing the Mahoning Sandstone at Top; the Upper Freeport Coal at the White Arrows in Middle; and the Upper Freeport Sandstone at the Bottom.....	288
XXVII.—Showing Bretz No. 2 Mine Tipple (No. 32 on Map II) and Behive Coke Ovens. Conemaugh Topography in Middle-ground and Pottsville Capping Chestnut Ridge in the Extreme Background.....	296
XXVIII.—Showing Upper Freeport Coal at Entrance to Mine No. 4 of the Elkins Coal & Coke Co. at Kingwood.....	304
XXIX.—Showing Coke Ovens and Tipple of the Preston County Coke Company at Cascade.....	312
XXX.—Manheim No. 5 Plant of the Alpha Portland Cement Company, at Manheim, and Quarry in Greenbrier Limestone. Outcropping Rocks in the Catskill, Pocono, Greenbrier Limestone, Mauch Chunk and Pottsville Series.....	320

	Facing Page
XXXI.—Lime Kiln Ready to Burn on Farm of J. W. Parks near Eglon	328
XXXII.—Quarry in the Saltsburg Sandstone of the Conemaugh Series near Kingwood, Operated by the Kingwood Quarries Company	336
XXXIII.—Cutting Plant of the Kingwood Quarries Company near Kingwood	344
XXXIV.—Quarry in Rowlesburg Sandstone at Rowlesburg, Showing Ripple Marks and Mud Cracks on Large Boulder.....	352
XXXV(a).—Quarry of the Terra Alta Lime Company in the Greenbrier Limestone, 2 Miles Northeast of Terra Alta.....	360
XXXV(b).—Quarry in Clarion Sandstone near Irondale, Operated by the Warfield Sand & Stone Company for Glass Sand.....	360
XXXVI(a).—Old Valley (Douglas) Furnace in Northwest Corner of Preston County. Topography Affected by Rocks of Pocomo, Greenbrier Limestone, Mauch Chunk and Pottsville...	368
XXXVI(b).—Showing Tipple at Shaft Mine of the Hamilton Coal & Coke Co. at Newburg, and Topography of the Conemaugh Series	368
XXXVII(a).—Showing Falls of Big Sandy Creek at Rockville, Flowing over Ledge of Upper Connoquenessing Sandstone..	376
XXXVII(b).—Showing Upper Falls of Big Sandy, 1.1 Miles Northwest of Rockville, at Comparatively High Water Stage, Formed by the Upper Connoquenessing Sandstone.....	376
XXXVIII(a).—Showing Lower Falls of Big Sandy, Creek, 1.3 Miles Northwest of Rockville, Formed by Lower Connoquenessing Sandstone.....	384
XXXVIII(b).—Showing Rapids of Lower Falls of Big Sandy Creek	384
XXXIX(a).—Showing Cascade Falls of Deckers Creek along the M. & K. R. R., Formed by One of the Pottsville Sandstones	392
XXXIX(b).—Showing Typical Pottsville Topography Forest Conditions Originally Along the M. & K. R. R. near Cascade....	392
XXXX.—Timber Slashings in Foreground Left and Topography of the Chemung Rocks, Looking up Bear Run of Horseshoe Run	400
XXXXI.—Showing the Harlem Coal and the Marine Fossiliferous Ames Shale and Limestone Along M. & K. R. R. Grade, 1½ Miles Northeast of Kingwood. Coal is at Track Level and Fossils at Horizon of Hammer.....	408
XLII.—Fauna of the Conemaugh Series.....	548
XLIII.—Fauna of the Conemaugh Series.....	550

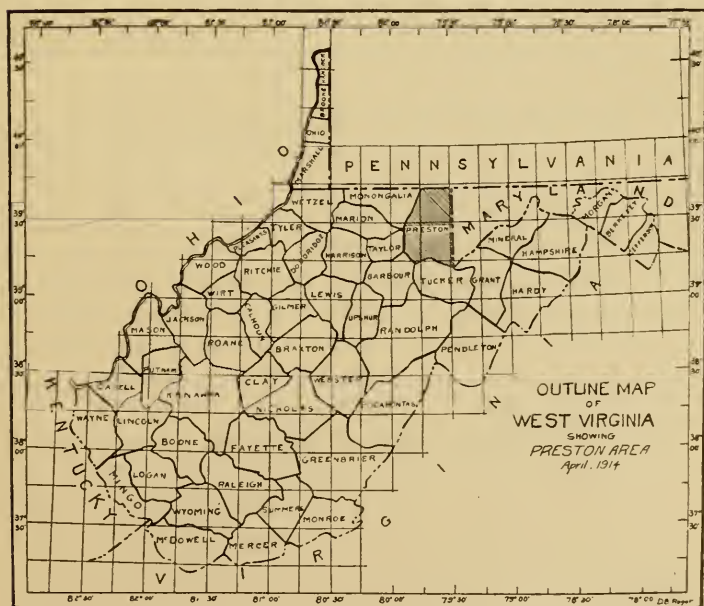
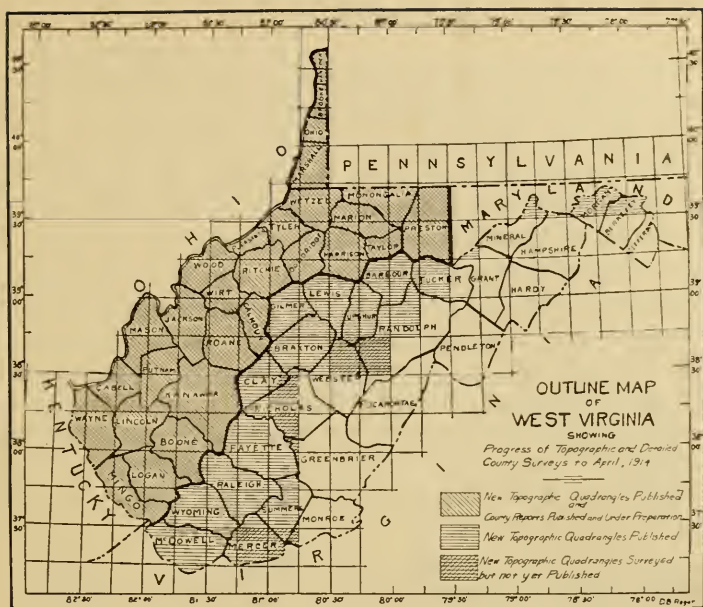
Figures.

	Page
1. Map Showing Progress of Topographic and Geologic Mapping in W. Va.....	XVII
2. Map Showing the Location of the Preston County Area.....	XVII
3. Diagram Showing the Relative Position of Coal Seams.....	262
4. Showing Area of Pittsburgh Coal. (See Explanations in Preface)	264
5. Showing Area of Bakerstown Coal. (See Explanations in Preface)	267
6. Showing Area of Upper Freeport Coal. (See Explanations in Preface).....	270
7. Showing Area of Upper Kittanning Coal. (See Explanations in Preface).....	313
8. Showing Area of Lower Kittanning Coal. (See Explanations in Preface).....	326
9. Showing Area of Clarion Coal. (See Explanations in Preface)	350
10. Showing Movable Area Only of the Quakertown Coal. (See Explanations in Preface).....	359

AUTHORS' PREFACE.

This Report gives (1) a brief history of the county and its development; (2), a study of its drainage systems and topography and their relation to geologic structure along with an accurate map—marked Map I—showing the culture and topographic features; (3), a Chapter on the geologic structure along with a second map—designated Map II—showing structure contours on the top of the Upper Freeport Coal bed over a large portion of the county and five cross sections giving a general idea of the structure where it was not possible to show it closely by contours; (4) seven Chapters on the general geology and detailed stratigraphy, the areal outcrop of the different divisions of the rock column being shown on Map II; (5), a Chapter on the oil and gas possibilities, with suggestions to operators prospecting for same in the future, the accurate location of test borings, all of which were non-productive, being shown on Map II; (6), a Chapter on the minable coal seams grouped both by geologic series and by magisterial districts, with a table giving their chemical composition, calorific value and fuel ratio, and another, the approximate available tonnage; (7), a Chapter on the clays, limestone and road material; (8), a Chapter on the building stone, glass sand, iron ore, water power, mineral waters and forests; (9), a Chapter on the soils of the area and their products; (10), a Chapter giving railroad levels; and (11), Part IV, giving an account of the marine fossil fauna of the Conemaugh Series.

Special attention is called to the structure contour lines in green on Map II, which show the elevation above sea level of the horizon of the Upper Freeport Coal. These contour lines, separated by 25 feet in elevation, except on the steep slopes of the Chestnut Ridge anticline northward from Gladessville; the steep slopes along the western flanks of the Briery Mountain and Etam anticlines; and in the Corinth region of the Mt. Carmel Basin. In the three last mentioned localities, the contour interval is 100 feet.



Special attention is also called to the "Prospective Oil and Gas Areas" by magisterial districts and page references in the Index under that heading.

The chapter on Coal gives the thickness, character and areal distribution of the several minable beds, along with an estimate of the available area and tonnage of ten different seams. The commercial mines are referred to in the table of analyses at the end of Chapter XII by serial numbers, the same corresponding to numbers assigned to the symbol designating the accurate location of the opening on Map II. Figures 4 to 9, inclusive, published in the same Chapter, are intended to show at a glance the total area of the coal, minable and unminable. In referring to these figures it must be remembered that there are numerous patches within the shaded areas where the coal is too thin or impure or both to be minable, and where there is doubt, the detailed sections and descriptions of the coals, given both by series and magisterial districts in the text, should be consulted for its character in any particular region. Figure No. 10 differs from those last mentioned, in that the shaded areas show only the regions in which the Quakertown Coal is known or believed to be present in minable quantity and purity.

The valuable deposits of clay, limestone, building stone, and glass sand have been given considerable space in Chapters XIII and XIV, as also the great water power resources.

Three maps accompany the report under a separate cover, of which Map I shows the character of the surface, the roads, streams, railways, etc.; Map II, the general and economic geology, coal test borings and other items of interest mentioned above; and Map III, the classification and areal distribution of the soils. In the text, these maps are referred to frequently by their Roman numerals, as Map I, Map II, and Map III.

The authors spent the regular field season of 1912 in collecting data for this report and a few short trips in the early part of 1913. Owing to the labor required in the completion of the voluminous Monongalia-Marion-Taylor Report, the manuscript for the Preston Area was not finished until March of this year.

Mr. Hennen, the senior geologist, is the author of Chap-

ters VI to XIV, inclusive. Mr. Reger is the author of Chapters I to V, inclusive, and he also prepared the structure contours, with some slight modifications, and the cross sections on Map II. There is a dual responsibility for the entire report, including maps, as throughout their preparation there was a constant interchange of ideas on the work in hand.

Mr. R. M. Gawthrop, Field Assistant, rendered very efficient service in the office in relieving the authors of a considerable portion of the tabular work, compilation of sections, boring records, drafting, etc.

Chapter XV, on Soils, as also Map III, is the exclusive work of W. J. Latimer, of the Bureau of Soils, of the U. S. Department of Agriculture, Washington, D. C. The suggestions therein offered for increasing and preserving their fertility cannot fail to interest the progressive farmers of the county.

Part IV, Chapter XVII, gives a description of the fossil fauna of three marine horizons in the Conemaugh; namely, Ames, Pine Creek, and Brush Creek limestones. This is the exclusive work of W. Armstrong Price, Paleontologist, who collected the specimens in the field during 1913.

The chemical analyses and heat determinations were made in the Survey laboratory of J. Berghius Krak, Assistant Chemist, with the assistance and supervision of B. H. Hite, Chief Chemist.

Much valuable aid and assistance were rendered to the authors by residents of the county and the officials of the several companies engaged in the development of the deposits of coal, glass sand, limestone, building stone and fire clay. Due credit and acknowledgment have been given in the text for all such data obtained.

The authors take this opportunity to express their obligations to I. C. White, State Geologist, whose suggestions and careful supervision of manuscript have added much to the value of this report.

RAY V. HENNEN,
DAVID B. REGER.

Morgantown, W. Va., April 1, 1914.

PART I.

The History and Physiography of Preston County.

CHAPTER I.

THE HISTORICAL AND INDUSTRIAL DEVELOPMENT.

LOCATION.

Preston county, the area treated in this report, lies within a right angle formed by the southern boundary of Pennsylvania and the western boundary of Maryland, being entirely included within the parallels of $39^{\circ} 11'$ and $39^{\circ} 44'$ North Latitude and $79^{\circ} 29'$ and $79^{\circ} 54'$ West Longitude from Greenwich. That portion of the county which adjoins Maryland, comprising a tract more than a mile wide and 36 miles long, has been the subject of an extended dispute between the two states, which was settled finally in 1912 by the Supreme Court of the United States after extensive surveys made by a commission composed of Julius K. Monroe of West Virginia, W. McCulloh Brown of Maryland and Samuel S. Gannett of the United States Geological Survey. The dispute arose over the uncertain location of the source of the Potomac river which was named originally as a point on the line. The contention of West Virginia that the Fairfax Stone, and not the Potomac Stone as claimed by Maryland, is a point in the line was allowed by the Court, and in accordance with this decision the

line was run and marked with permanent concrete monuments and the monuments of former surveys were destroyed. The state line, as located by the commission, is now published for the first time free from dispute on Maps I, II and III in the separate atlas that accompanies this report.

Since the majority report of the commission, which was confirmed by the Court, contains valuable historical and scientific data, it is here published in full.

SUPREME COURT OF THE UNITED STATES.

No. 1, Original.—October Term, 1911.

"The State of Maryland, Complainant,	} In Equity.
vs.	
The State of West Virginia.	

"The State of West Virginia having moved the Court to take up for consideration the exceptions heretofore filed in this cause by the State of Maryland to the report of Commissioners Julius K. Monroe and Samuel S. Gannett, two of the Commissioners who were appointed by the decree entered in this cause on the 31st day of May, 1910, to run, locate and permanently mark, with suitable monuments, the Deakins or Old State Line, as the boundary line between the States of Maryland and West Virginia, from low water mark on the South ern bank of the North Branch of the Potomac River to the Pennsylvania line, and to overrule said exceptions and confirm said report, which report is in the words and figures following, to wit:

To the Honorable Chief Justice and the Associate Justices of the Supreme Court of the United States:

"We, Julius K. Monroe and Samuel S. Gannett, two of the Commissioners appointed under the decree of the Court rendered May 31, 1910, 'to run, locate and establish and permanently mark with suitable monuments the said Deakins or 'Old State Line' as the boundary line between the States of Maryland and West Virginia from said point (low water mark) on the southern bank of the North Branch of the Potomac River to the said Pennsylvania line, etc.' have the honor to submit the following report, and map entitled, 'Map Showing The Boundary Line Between Maryland and West Virginia, from the Potomac River to the Pennsylvania State Line, as surveyed and marked under the decree of the Supreme Court of the United States, rendered May 31, 1910,' etc.:

"The party was organized and went into camp on July 12, 1910, on Arnold's Ridge, about one mile north of the North Branch of the Potomac River, and immediately began the survey of the line."

"Beginning at the Fairfax Stone, a line was first run North 0° 56' E. along a well marked line to a planted stone marked

B
"1101," at the southwest corner of Military Lot, No. 1101, originally a 'bounded maple standing one mile north from a stone fixed

by Lord Fairfax for the head of the North Branch of the Potowmack River.' The intersection of this line with the south bank of the North Branch of the Potomac (at low water mark) was, under the decree of the Court, fixed as the corner of Maryland and West Virginia, and monument No. 1 was therefore erected at this place and became the initial point of the boundary line run in 1910 and 1911.

From the corner of lot 1101B, where monument No. 2 was erected, the line deflects slightly to the west and follows the old marked line on the course N. $0^{\circ} 47' 53''$ E. as identified by the surveyors in the case in 1897 and shown on the maps filed by the defendants. This line crosses Arnold's Ridge, Laurel Run, Backbone Mountain, Youghiogheny River, and where it intersects the 3d line of a Maryland tract called 'Covent Garden' monument No. 4 was erected and an offset was made to the west. The 3d line of Covent Garden was followed for a distance of 402.15 feet on the course N. $71^{\circ} 48' W.$ (true) to a planted stone, acknowledged by residents and owners of adjoining property and pointed out by them as being the limit of their respective claims, at this point. Monument No. 5 was built over this stone and the line was run N. $0^{\circ} 27' 04''$ E. in a manner to follow the property lines, as acknowledged by the citizens of the two states; passing over the center of a planted stone property corner, which marked the beginning of the Maryland tract called Mount Pleasant, surveyed in 1774. Monument No. 6 was built over and around this stone, which was pointed out by witnesses as marking the place of the original corner, a white oak tree. Continuing on the same course, a large anciently marked white oak tree was reached and identified as the beginning of a Virginia tract of land surveyed for John Pettyjohn in 1781, and also a corner of John T. Goff 1000 acres, survey made in 1782, both of which call for the boundary line. This tree was cut and blocks taken out by your Commissioners which showed surveyors' axe marks in the wood; one 130 years old, one 117 years, and the last 78 years, thus indisputably establishing this course as following the oldest marked line extant. The stump of this tree was removed and monument No. 8 was built in the exact spot occupied by it. Upon trial it was found that from this white oak, northward, the line between property holdings of citizens in the two states, verged to the eastward, and a slight angle was therefore made to the east and the boundary line run N. $0^{\circ} 42' 57''$ E. to the stump of a bounded sugar tree, the northwest corner of a Maryland tract called Eelshine; this tree, while standing, was identified by the surveyors in this case in 1897, and also by the owners of the tract. The land since that time has been cleared, and the timber destroyed by fire. The stump of this sugar tree was again pointed out to the Commissioners, in 1910, by Peter F. Nine, the present owner of the tract Eelshine. This stump was removed and monument No. 10 erected exactly where it stood.

From this point the boundary line runs S. $89^{\circ} 17' 03''$ E 482.3 feet along the line common to the tract Eelshine and the Virginia Grant to Wm. Ashby for 50 acres, to the southwest corner of the Maryland tract called Buckdale. As the southwest corner of Buckdale and the southeast corner of the Ashby 50 acre tract, which are common, could not be definitely located upon the ground, as all original objects marking the line had been destroyed, this point was determined by the intersection of the line produced southward passing through the known and accepted corner of the Old Line, namely: 'the stake and stone pile,' on I

land tract called 'Maryland,' and the Virginia grant to John Hoyer for 500 acres, and which was identified and located by the surveyors in this case in 1897, and shown at Red 'C-6' upon Map No. 1, filed by defendants, and again identified by your Commissioners in 1910; and a point north of the B. & O. Railroad near Hutton, Maryland, in the property line between lands of the Connell Heirs and George Morris. Monument No. 11 was placed at the intersection of the line above described with the line eastward from Monument No. 10. The course of the boundary from Monument No. 11, as above determined is N. $0^{\circ} 41' 02''$ E. following closely the lines of the original Virginia grants, and passing through, or very near the several points indicated upon Map No. 1 filed in this case by defendant, and testified to as standing in the 'Deakins, or Old State Line,' to a point on Glover's Hill, $1\frac{1}{2}$ miles north of the Baltimore & Ohio Railroad, where Monument No. 15 was erected. From this point northward it was found that the general course of the property lines verged slightly to the west, and the course of the boundary was here changed to N. $0^{\circ} 22' 27''$ E. to conform thereto, following the well marked divisional lines between the F. & W. Deakins 6000 acre Virginia grant, and the Maryland Military Lots (Nos. 1237 to 1245) and the eastern line of the Hoyer and Martin 3600 acre Virginia grant, passing over the summits of Snaggy Mountain and through the southern end of the Pine Swamp to a point where this line intersects the southern line of the John Crane 776 acre Virginia grant, a short distance north of the Cranesville and Oakland road, as indicated upon the maps filed by the defendant in this case. This point was determined by reproducing upon the ground the southern line of said 776 acre Crane Survey. Monument No. 19 was erected at this point.

"From Monument No. 19 an offset of 971.09 feet was made along the south line of the John Crane 776 acre tract N. $89^{\circ} 27' 27''$ E. to its intersection with the west boundary of Maryland Military Lot No. 1292, where Monument No. 20 was built. The boundary here turns northward, following the west limit of Military Lots 1292, 1294, 1296, 1298, 1400 & 1402 as laid out by Francis Deakins, on a true course of N. $0^{\circ} 17' 00''$ E. to the northwest corner of Military Lot 1402. Monument No. 21 was placed at this point and an offset made 53.69 feet S. $89^{\circ} 43' 00''$ E., along the north side of Lot 1402, (which is also the division line between lands of E. F. Jenkins and M. H. Frankhouser), where Monument No. 22 was erected.

"From Monument No. 22 the course of the boundary is N. $0^{\circ} 24' 42''$ E., passing through, or near the point where a large marked Red Oak formerly stood, testified to in this case by Ethbell Falkenstine, as standing in the Deakins or Old State Line, and shown at the letters 'W-K' upon the maps heretofore filed; a planted stone, a short distance north of the Red Oak in the east line of the Henry Banks Survey of 8000 acres, and following a well marked line along and with the eastern boundary of the Banks Survey and the western boundary of the Maryland tract called 'Canrobert' to a point where it intersects the south line of the 328 acre tract granted by Virginia to Henry Deal, and passing through the same, to a point where the east line of the Banks Survey intersects the south line of a tract of 367 acres granted by Virginia to Henry Deal, where Monument No. 27 was erected.

"From Monument No. 27 an offset of 7.3 feet N. $89^{\circ} 25' 12''$ E. along the line between the tracts above mentioned, where Monument No. 28 was erected.

"From Monument No. 28 to Monument No. 32 the course of the boundary is N. 0° 20' 07" W. and closely follows the mutually accepted property lines of citizens of the two States; corners, trees, and fences having been pointed out by various land owners on both sides of the 'Old Line.' Monument No. 32 replaces a large marked Spanish Oak, which was a common corner of lands owned by John and George W. Vansickle, in West Virginia, and in the west line of land owned by W. M. Fike in Maryland. This tree was cut down and the stump removed by your Commissioners in 1911. From this point northward it was found that the old accepted boundary line veered slightly to the east, and the course of the boundary line was therefore changed to N. 0° 4' 55" E. to conform to it.

"Monument No. 34 was set at the intersection of this line with the southern boundary line of the State of Pennsylvania.

"In addition to the monuments just mentioned as standing at the angular points in the boundary, others were set between, exactly in line. (See description of Monuments).

"The total number of large monuments erected along the Maryland-West Virginia boundary line is 34, in addition to the one restoring the 'Fairfax Stone.' Of small monuments, 26 were erected, making a total of 60 permanent marks. The line is also marked at suitable places by 5 copper bolts securely fastened into natural and planted rocks.

"A description of instruments and methods used in the survey, the method of constructing the monuments; location, latitude, longitude, approximate elevation, distance, true and magnetic bearings, will be found in the following pages.

Instruments.

"The following instruments were used in making the survey: Theodolite, 7½ inch No. 11, United States & Canada Boundary Survey, temporarily loaned during 1910 to this Survey. In 1911, 7½ inch theodolite No. 219 of United States Coast & Geodetic Survey, loaned by the Superintendent of that Bureau in place of No. 11. No. 219 is lighter, works more freely, and altogether much more satisfactory than No. 11. The circles on both theodolites are graduated to 10' spaces and read by verniers to 10". With these instruments the line was ranged out from hilltop to hilltop and flagpoles set at intervals of 1 to 4 miles.

2 Gurley transits, circles 5½ inches diameter reading by vernier A. to minutes and by vernier B. to hundredths of a degree, loaned by Julius K. Monroe. With these transits the line was run from flagpole to flagpole, previously located with the theodolite, in the usual manner with double backsights and foresights. The length of foresight was limited by the length of tape, 500 feet; the length of backsight was limited only by the visibility of the rear tripod. Instead of the ordinary rods for lining in, brass plumb bobs weighing 2 pounds each, supported by tripods 7 feet high, with movable heads were used. As sights were taken on the string supporting the plumb bobs, the line was produced with great accuracy. A brass tack was set in a solid hub at each transit station.

Distances.

"Distances were measured to the nearest 1/100 of a foot with a 500 foot standardized steel tape, supported at several points along

its length so as to have a uniform slope, approximately parallel to the slope of the ground.

"The inclination or slope of the tape was measured by the vertical circle on the transit and the horizontal distance and difference in elevation carefully computed.

"Besides the 500 ft. steel tape, which was graduated to single feet, except at each end, where 1 foot was graduated to tenths, a 100 foot steel tape graduated throughout to feet, tenths and hundredths was used for shorter measurements.

Astronomical Observations.

"Astronomical observations for azimuth were obtained with the theodolite by observing Polaris near eastern elongation. Ten measurements of the angle between star and mark were made with telescope direct and reversed in 5 positions of the circle. The mark was a bulls-eye lantern placed at one of the transit stations a mile or more distant, northward. Time was obtained from the railroad; a mean time Waltham watch being compared with 75th meridian time as sent by telegraph from the United States Naval Observatory at Washington each noon, and proper reduction was made for difference in longitude. Azimuth observations were made at 8 stations along the boundary line, 36.7 miles in length; usually at or near a point of deflection in the final line.

Geodetic Positions.

"At a point near Cranesville, West Virginia, 24 miles north of the Fairfax stone and 12 miles south of the Pennsylvania line, connection was made with Piney Swamp triangulation station located by the United States Geological Survey by a belt of triangulation extending westward from Maryland Heights and Sugarloaf, 2 primary triangulation stations of the Coast and Geodetic Survey. The geodetic position of Piney Swamp station is on United States Standard datum, and is thus free from station error. A portion of the boundary line, 1.9 miles east of this station, measured during the progress of the survey, was used as a base line, and by measuring all the angles in 2 triangles accurate connection was made with this triangulation station. From these data the geodetic positions of all large monuments were computed.

Elevations.

"The approximate elevations of all stations were determined by carrying a line of vertical angle measurements along the boundary. The elevation of Fairfax Stone was accepted as 3162 feet above mean sea level as derived from railroad levels, and checks on the heights as computed from this, were obtained at 5 points from the topographic work of the United States Geological Survey, as follows: Near Gnegy Church; at the crossing of the Northwestern Pike; at Hutton; near Cranesville; and at the intersection of the Maryland-West Virginia line with the Pennsylvania state line. The apparent errors at these check points were distributed at the various stations in proportion to the distance.

MONUMENTS.

List of Monuments from the Fairfax Stone to the Pennsylvania Line, Giving the Size, Method of Construction, and Location—Together with the Latitude and Longitude of Each of the Principal Monuments.

"The PRINCIPAL MONUMENTS are uniform in size and shape, and consist of a moulded concrete column, twenty-two inches square at the base, tapering to ten inches square at four feet in height, (top of mould) and finished, in a few instances, with rounded top, but generally in flat, pyramidal shape extending four to five inches above the top of mould, or form, making the entire column four feet four inches in height above base; the corners are beveled one and one-half inches in width to prevent defacement.

"INSCRIPTIONS: Each Monument, beginning with the initial one at the North Branch of the Potomac River, is numbered consecutively from 1 to 34 Northward to the Pennsylvania State Line; the numbers and the names of the Commissioners being placed upon the south face of the monument, except where set diagonally; the date, 1910, on the North face; the letters MD. on the East, and W. VA. on the West. The letters MD., and W. VA., are $3\frac{1}{4}$ inches in height and $\frac{3}{8}$ inch deep; the numbers $2\frac{3}{4}$ inches high, and $\frac{1}{8}$ inch deep, and the names of Commissioners, one inch in height and of proportional depth. The inscriptions were moulded in the monuments when built, (except the monument at Fairfax Stone, and Nos. 1 and 2) by means of reversed bevel faced brass and lead pattern letters, which were attached separately to the inside of the 'forms'; subsequently the letters MD., W. VA., the names of Commissioners, and the date, 1910 were soldered on plates of tin reinforced with heavy sheet iron, which were securely fastened to the forms with screws. These plates were depressed slightly below the surface, which, on the finished monuments, formed corresponding elevations.

Material.

"Three bags (300 pounds) best Portland cement, and seven bags (700 pounds) washed, white sand, were used in each of the large monuments. The cement and sand were thoroughly mixed before and after adding water. This material was firmly tamped in the 'form.' the top being finished with an ordinary mason's trowel. No stone was used in the monument.

Base.

"The base of each of the principal monuments was made of concrete, the usual size being $3\frac{1}{2}$ feet square, and $2\frac{1}{2}$ feet deep, depending upon the character and formation of the ground; in all cases sufficient depth and breadth being obtained to insure stability.

"The average amount of material used in each base, was $\frac{3}{4}$ barrel of best Portland cement, 1200 pounds of sand, and 1500 to 2000 pounds of broken stone. The cement and sand were thoroughly mixed before and after adding water; cement and stone were placed in the excavations in alternate layers and the whole thoroughly tamped and bonded. The base was finished and cross-lines indicating its exact center marked upon it, and when firm enough to sustain the weight of

the monument, the 'form' was set up and carefully centered by means of the cross-lines, and the monument built before the final 'set,' thus forming the base and column into one solid mass. In a few instances where the bases were built a day or more before the monument, a large stone was set in the center of the base and allowed to project a foot or more above the surface, and the monument built around it, thus securing a firm bond.

Small Monuments.

"Small monuments are also of concrete, uniform in size, 1 foot square and 2 feet high, moulded in a wooden form, without taper, and contain 1 bag (100 pounds) cement, 2 bags (200 pounds) washed, white sand. The top was finished in a similar manner to the large monuments. The letters MD. cut on the east face, W. VA. on the west, and the date, 1910, on the north. The base, 2 feet square and 2 feet deep, also of concrete, and built as in the larger monuments. One bag of cement and four bags of sand, in addition to the broken stone, were used.

The 'Fairfax Stone.'

"The 'Fairfax Stone' stands at the head of the North Branch of the Potomac River. It derived its name from Thomas, Lord Fairfax, who became proprietor of what was known as the 'Northern Neck of Virginia.' The original grant was made in 1663, by Charles II of England, and subsequently successively confirmed by James II and George II. The title having rested by transfers in Lord Fairfax, on the 7th of September, 1736, Commissioners were appointed, with the approval of George II, to define the boundaries of the grant, which was to be 'all the land lying and situate between and within the heads of the Rivers Rappahannock and Potomac, the courses of the said rivers together with the rivers themselves.' The survey of the upper part of the Potomac River was made in 1736, and at the head spring as then determined a number of trees were marked by the surveyors. A dispute arose between Lord Fairfax and the representatives of the Colony of Virginia as to the source of the Potomac, and no further work or agreement reached until 1746, when representatives for each side having been named, the survey was resumed and a line was run from the head of the Rappahannock to the head of the Potomac River. The trees and springs located in the former survey of 1736, as the head of the Potomac having been found, the course of the trial line was corrected and the final line run in the reverse direction from the Potomac to the Rappahannock.

"Before leaving the head of the Potomac, additional trees were marked and a stone set up, described as follows, in the note book (still in existence) of Thomas Lewis, one of the surveyors: 'October 23, 1746, Returned to the spring where we made the following marks; '—' on another Beach WB WR 1746 Y3—a stone

by the corner pine marked $\overline{FX}$, on a Beach marked AC.' This done we bid adieu to the head spring about $\frac{1}{2}$ hour after nine o'clock, our course directing to the head of Rappahannock bearing S. 46° E. 30 poles the top of the mountain in the spring heads on.'

"When Lieut. N. Michler made his survey of the meridian line north from the Fairfax Stone in 1859, he thus describes the stone

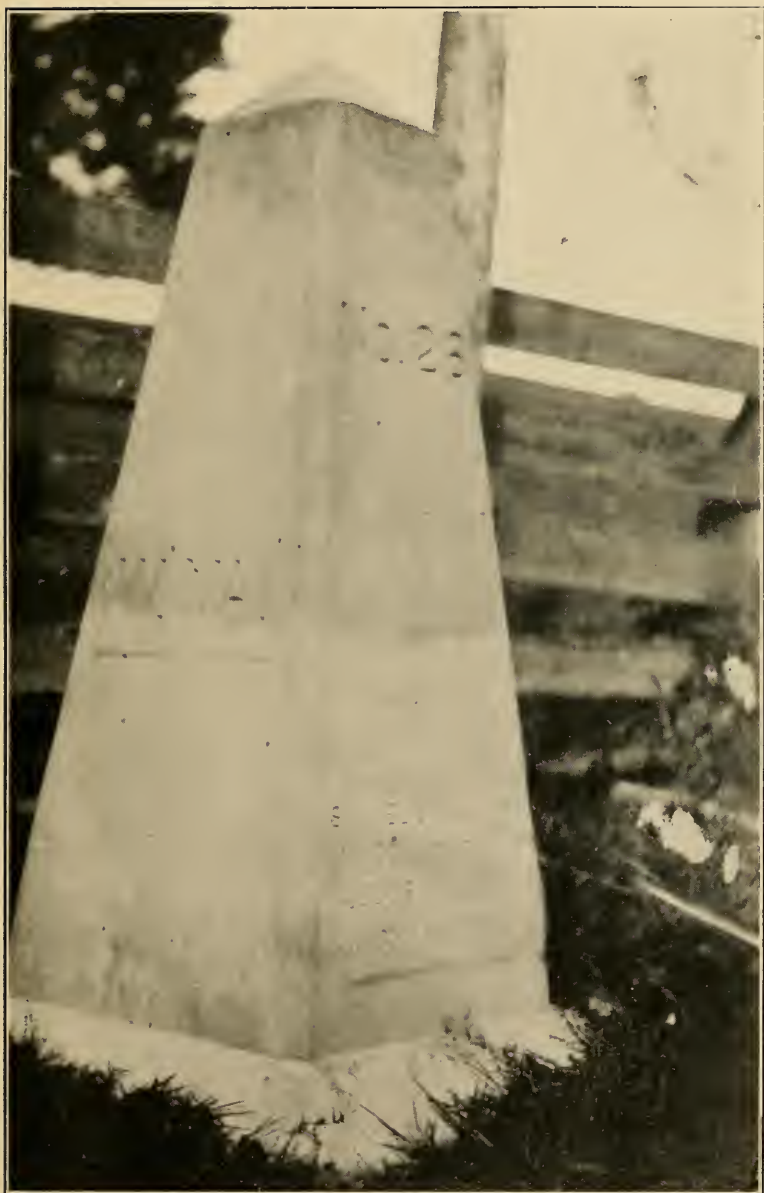


Photo by E. E. Knight
PLATE II.—Type of concrete monument marking final determination
of the Maryland-West Virginia State Line along east boundary of
Preston. (See Text).

in his report. 'The initial point of the work,—the Fairfax Stone,—stands on the spot encircled by several small streams flowing from springs about it. It consists of a rough piece of sandstone, indifferent and friable, planted to the depth of a few feet in the ground and rising a foot or more above the surface, shapeless in form, it would scarce attract the attention of the passer by. The finding of it was without difficulty, and its recognition and identification by the inscription Fx, now almost obliterated by the corroding action of water and air. In order not to disturb this stone the first observatory was built immediately in the rear (South) of it.' Here, later, Michler built his monument, which was about 4 feet in height and made of several hewn stones, the upper ones being conical. The original Fairfax Stone was in existence until about the year 1883, when it was destroyed by vandals and subsequently carried away, leaving the Michler monument as the only marker.

"The stream surveyed in the year 1736 was what has since been designated the North Branch of the Potomac River. The source, designated as the Fairfax Stone, is upon the divide between the eastern and western water sheds. It is $\frac{1}{4}$ mile northerly from the summit of the Western Maryland Railroad, which is here the highest point on that line between Cumberland, Maryland, and Elkins, West Virginia.

"The stone is easily reached by a trail from Fairfax Station, which is $\frac{1}{2}$ mile to the southeast. The large timber all around has been cut by mill men and fire has destroyed the balance so that the immediate spot is now largely covered by brush and briars. The land near the Fairfax Stone is principally owned by the Davis Coal & Coke Company (in 1910).

"On August 12, 1910, during the present work, a new concrete monument was built, replacing both the previous marks. The new monument stands 2 feet North of the center of the base of the Michler Monument, which point was marked by a brass bolt bedded level with surface of the ground. This rock and mark are still left in place but are not visible, and the mark is 1 foot north of the point where the original stone stood. The portion of the Michler Monument above ground was removed.

'Fairfax Stone,' Restored 1910.

"The base is of concrete $3\frac{1}{2}$ ft. square and 2 ft. deep set flush with surface of ground. On this base the monument was built, utilizing the form which had been designed for, and was afterwards used in the construction of the monuments along the boundary from the Potomac River to the Pennsylvania line. The monument is 22 inches square at the base and 10 inches square at the top, the latter being built up a few inches and rounded off. The total height being 4 ft. and 4 inches above the base. The monument contains $3\frac{1}{2}$ bags of best portland Cement and $6\frac{1}{2}$ bags of white sand. It is marked as

follows: On South face $\begin{matrix} \text{Fx} \\ 1746 \end{matrix}$ On North face 1910.

"The corners are beveled $1\frac{1}{2}$ inches in width.

"Latitude $39^{\circ} 11' 41.92''$. Longitude $79^{\circ} 29' 15.50''$.

Monument No. 1.

"This monument marks the initial point of the present Boundary Survey. It is on the South bank of the North Branch of the Potomac

River, 3983 feet N. $0^{\circ} 56'$ E. (true) from the Fairfax Stone. The base is $3\frac{1}{2}$ ft. square and 4 ft. deep and tapers to $2\frac{1}{2}$ ft. square at its top. The monument is placed diagonally on this base and is marked as follows:

"On the Northeast side ¹⁹¹⁰MD. On the Southeast side W. Va.

"On the Southwest side ^{No. 1}W. Va. On the Northwest side W. Va.

It can be reached from the Fairfax Station of Western Maryland Railroad by following an old lumber tram road which goes within 100 yards of the river. From the north on Maryland side there is a bridle path leading from the County Road on Arnold's Ridge, to a point almost in sight of this monument, $\frac{1}{2}$ mile distant.

"Latitude $39^{\circ} 12' 21.34''$. Longitude $79^{\circ} 29' 14.67''$.

Monument No. 2.

"Is in place of a maple tree marked '1101' which was the beginning of the Maryland Military Lot 1101. It can be reached from the county road on Arnold's Ridge by the same trail that leads to the river. It is less than $\frac{1}{4}$ mile from top of the ridge and about 1 mile west of Eli Mosser's house. The boundary line makes a slight angle to west at this point.

"Latitude $39^{\circ} 12' 33.28''$. Longitude $79^{\circ} 29' 14.42''$.

Arnold's Ridge.

"A small monument on the highest point of Arnold's Ridge. It is one mile west of house of Eli Mosser and can be reached by the county road along the ridge.

Monument No. 3.

"On the summit of Backbone or Great Savage Mountain. The base of monument rests on the solid ledge which forms the crest of the mountain. It is reached with difficulty by an old road crossing the mountain from Eli Mossers to Sommers Mossers upon the west and is more than $\frac{1}{4}$ mile west of this trail over rough, rocky ground. It can most readily be reached from the west. There is an extended view from this summit as far north as Snaggy Mountain.

"Latitude $39^{\circ} 14' 12.43''$. Longitude $79^{\circ} 29' 12.65''$.

Stahlnaker Ridge.

"A small monument about 1 mile west of Sommers Mossers, and $\frac{1}{2}$ mile southwest of county road from Gnegy Church to Breedlove.

Monument No. 4.

"Just north of the Youghiogheny River and south of a county road from Gnegy Church to Breedlove. It is in the line of a Maryland land grant called Covent Garden and in property line of Wm Bittner and Oscar Roth. It is $\frac{3}{4}$ mile south of Gnegy Church and is easily reached. The monument stands diagonally as the line here changes its course to the westward.

"Latitude $39^{\circ} 15' 53.73''$. Longitude $79^{\circ} 29' 10.84''$.

Monument No. 5.

"About 100 yards north of county road from Gnegy Church to Breedlove and in sight of road. It is in a line of the Covent Garden Survey, and is in or near property lines of Wm. Bittner, Chas. Winters, Oscar Roth and J. Stahlaker. The monument was built over and around a rough stone marking property corners and stands diagonally as the course of the boundary line here turns northward.

"Latitude $39^{\circ} 15' 54.97''$. Longitude $79^{\circ} 29' 15.69''$.

Monument No. 6.

"On the south side of the county road from Oakland to Horse Shoe Run, 100 yards southwest of the cross roads at Gnegy Church. On or near the property line of Daniel Gnegy and Elijah Bechtel. The monument was built over and around a stone property corner which marked the beginning of the Maryland land grant called 'Mount Pleasant' surveyed in 1774. The original beginning called for was a white oak tree, now gone. The stone was pointed out as said beginning by Daniel Gnegy.

"Latitude $39^{\circ} 16' 31.10''$. Longitude $79^{\circ} 29' 15.32''$.

Hamstead Hill.

"A small monument on the Obed Hamstead Hill $\frac{2}{3}$ of a mile east of the southwest prong of the Youghiogheny River and $\frac{3}{4}$ mile north of Gnegy Church. The monument is 45 feet north of an east-west wire fence and 5 feet west of a north-south line fence.

Monument No. 7.

"Situated 15 feet south of center of county road from Cash Valley to the Horseshoe Run road and $1\frac{1}{2}$ miles east of Eglon, West Virginia. The land on the east of monument is owned by George H. Gauer and that on the west by William Weimer.

"Latitude $39^{\circ} 17' 46.83''$. Longitude $70^{\circ} 29' 14.56''$

Monument No. 8.

"About $1\frac{1}{2}$ miles northeast of Eglon, West Virginia, and 150 yards east of house of Silas Fike. This monument marks the spot where stood a large white oak tree called for in the Virginia Patent to John Pettyjohn, surveyed May 30, 1781, for 400 acres. The call being at 'a white oak in the Maryland line and running—and finally to pointers in the Maryland line and with said line N. 226 poles to the beginning.' This tree was blocked during the survey of 1910 and the oldest mark counted 130 years growth, the second 117 years, and the third 78 years. The block was saved. The tree was cut down and stump blown up with dynamite and replaced by the monument which now marks property holdings of Silas Fike, Amelius Fike, and Seymour Hamstead. There is an angle to the east in the boundary line at this point.

"Latitude $39^{\circ} 17' 52.63''$. Longitude $79^{\circ} 29' 14.50''$

Silas Fike's Ridge.

"A copper bolt set in a rock flush with the ground on summit of a flat timbered ridge $\frac{1}{4}$ mile north of house of Silas Fike, who lives $1\frac{1}{2}$ miles northeast of Eglon, West Virginia.

Dawson's Hill.

"A small monument on wooded hill of Lloyd Dawson, about $\frac{3}{4}$ mile south of the Northwestern Pike. It is 26 feet west of north-south fence and 195 feet north of an east-west fence.

Monument No. 9.

"Situated 8 miles southwest of Oakland, Maryland, in an angle formed by the Northwestern Turnpike and the county road from Eglon, West Virginia, to Oakland. The monument is 100 yards east of the Youghiogheny River and is on a slight ridge between, above described roads and can be seen from them.

"Latitude $39^{\circ} 19' 07.61''$. Longitude $79^{\circ} 29' 13.29''$.

Offut's Hill.

"A small monument on summit of wooded hill belonging to D. E. Offut, $\frac{1}{4}$ mile north of the Northwestern Turnpike and 10 feet east of a north-south fence.

Stahl's Hill.

"A small monument on summit of Stahl's Hill, 20 feet west of an old split rail fence running north and south and is on land owned by Peter F. Nine.

Monument No. 10.

"In an open field about 300 yards south of a county road running east and west across the Youghiogheny River. The monument stands in place of a sugar tree which formerly stood here and marked a corner of the Maryland grant called 'Eelshine.' The place was pointed out by Peter F. Nine, who owns the property east of it. John Bittner owns the land to the west and his house is 100 yards west of the monument. The boundary line turns to the east and the monument stands diagonally.

"Latitude $39^{\circ} 20' 39.47''$. Longitude $79^{\circ} 29' 11.82''$.

Monument No. 11.

"Situated 482 feet east from Monument No. 10, as there is here an offset in the line. It is in the line of Eelshine and Ashby 50 acre survey, and stands diagonally as boundary line here turns to north.

"Latitude $39^{\circ} 20' 39.41''$. Longitude $79^{\circ} 29' 05.68''$.

Monument No. 12.

"Is upon the south side of the county road from Brookside, West Virginia, to Oakland, Maryland. It is about 100 feet north of the Youghiogheny River on land of Dorsey Ashby and about 100 yards southwest of his house.

"Latitude $39^{\circ} 21' 04.15''$. Longitude $79^{\circ} 29' 05.30''$.

Ashby's Hill.

"A small monument on summit of a flat ridge owned by Dorsey Ashby, $\frac{1}{4}$ mile northwest of road from Brookside to Oakland, and $\frac{1}{4}$ mile northwest of Mr. Ashby's house.

Lauer Hill (South Brow).

"A copper bolt set in a rock 6 by 6 by 20 inches set flush with surface of ground, on south brow of Lauer Hill $\frac{3}{4}$ mile south of house of Charles Fulks. It can be reached from the north by road and trail through the woods.

Monument No. 13.

"On the summit of Lauer Hill about 6 miles southwest of Oakland, Maryland. The monument can be reached by a trail running south from a road to a coal mine near Chas. Fulk's house, which is on the north side of Lauer Hill about $\frac{1}{2}$ mile from summit. The land is covered with timber and is owned by Daniel E. Offut.

"Latitude $39^{\circ} 22' 02.42''$. Longitude $79^{\circ} 29' 04.40''$.

Miller.

"A small monument on summit of flat ridge $\frac{1}{2}$ mile north of Laurel Run, on land owned by J. S. Miller. It can be reached by road from Crellin, Maryland, which is $1\frac{1}{2}$ miles to the east.

Poling.

"A small monument on a timbered ridge $1\frac{1}{2}$ miles northwest of Crellin, Maryland, and on land owned by Zach Poling. It is 120 feet south of a 2nd class road crossing the ridge.

White.

"A small monument $\frac{3}{4}$ mile south of Hutton, Maryland, on north-west side of a 2nd class road and is on land owned by Chas. White.

Monument No. 14.

"Is about 200 yards west of Hutton, Maryland, Station, B. & O. R. R., and close to south limit of right of way of main line of that railroad. It is north of wagon road from Hutton, Maryland, to Corinth, W. Va., is conspicuously placed, and can be seen from trains as they pass. It is near lands of John A. Connell, Chas. White, and Grant Felton.

"Latitude $39^{\circ} 25' 08.88''$. Longitude $79^{\circ} 29' 01.54''$.

Morris-Connell.

"A small monument on summit of flat ridge cleared on west and timbered on east. It is $\frac{1}{2}$ mile north of Hutton, Maryland, and is on land owned by George Morris on the west and J. A. Connell on the east.

Monument No. 15.

"About $1\frac{1}{2}$ miles north of Hutton, Maryland, or Corinth, West Virginia, and can be reached by road from Corinth. The monument is on cleared land owned by Dennis Glover. There is a slight deflection of the boundary line to the westward at this point.

"Latitude $39^{\circ} 26' 07.60$. Longitude $79^{\circ} 29' 00.63$ ".

Severe.

"A small monument on north side of county road 2 miles north of Corinth, West Virginia. On land owned by John M. Browning.

Browning.

"A small monument on summit of a flat wooded ridge owned by John M. Browning, $2\frac{1}{2}$ miles north of Corinth, West Virginia.

Camp Rocks.

"A copper bolt set in a hole drilled in top of and near the northeast corner of a rocky bluff on south slope of Snaggy Mountain. 700 feet south of old Burchinal road. Stones are piled around and over the bolt. From this point, Glover's Hill, Backbone Mountain, and other distant points southward can be seen.

Burchinal.

"1st. A small monument on top of a large flat rock 20 feet south of old Burchinal road which crosses Snaggy Mountain near this place.

"2nd. A copper bolt set in solid rock 350 feet north of the small monument described above.

"3rd. A copper bolt set in solid rock 1400 feet north of small monument described above.

Monument No. 16.

"On one of the main summits of Snaggy Mountain about 1281 feet east of the 'Fairfax Meridian,' and 75 yards from a rough road to fields on top of mountain. It can be reached either from the Burchinal Road, which comes out at White Oak Spring on the road to Terra Alta.

"Latitude $39^{\circ} 29' 07.98$ ". Longitude $79^{\circ} 28' 59.11$ ".

Monument No. 17.

"Is on the very high north summit or brow of Snaggy Mountain and is one of the highest points along the boundary line, being about 3070 feet above mean sea level. It can be reached either from a trail which crosses through the gap between Monuments 16 and 17, or from the Cranesville-Oakland road above Browning Lake, or by climbing the steep side of the mountain just south of Pine Swamp.

"Latitude $39^{\circ} 29' 50.50$ ". Longitude $79^{\circ} 28' 58.75$ ".

Teets.

"A small monument on north side of county road which crosses Pine Swamp about 3 miles south of Cranesville, West Virginia. The monument is about 1000 feet south of house of Eugene Teets.

Monument No. 18.

"On the north side of the county road from Cranesville, West Virginia, to Oakland, Maryland, and is about 3 miles south of Cranesville, 100 yards east of house of Eugene Teets, and west of Muddy Creek, and on the edge of Pine Swamp, which has here been drained.

"Latitude 39° 31' 38.50". Longitude 79° 28' 57.84".

Monument No. 19.

"Is about 2½ miles southeast of Cranesville, West Virginia, and is on the western edge of the Pine Swamp about 100 yards from solid ground. The foundation of the monument rests on hard sand 4 feet below the surface. The timber and brush near the monument are mostly dead or burnt. The land is owned by Hiram Ringer. The monument is set diagonally as the line turns abruptly east.

"Latitude 39° 31' 53.96". Longitude 79° 28' 57.71".

Monument No. 20.

"Near the middle of Pine Swamp about 3 miles southeast of Cranesville, West Virginia, ½ mile west of house of John H. Sommers and 50 feet west of Muddy Creek. The base of the monument is 4 feet square and 6 feet deep, resting on a sticky clay. The surface of the swamp near this monument is very soft and all material had to be drawn by men on a sled for a distance of 200 yards. The land is owned by Hiram Ringer, and the adjoining land to the east by John H. Sommers. The Monument is set diagonally.

"Latitude 39° 31' 54.05". Longitude 79° 28' 45.32"

Monument No. 21.

"One mile east of Cranesville, West Virginia, in a small ravine, and is on property line between M. H. Frankhouser and E. F. Jenkins at the Northwest corner of Maryland Military Lot 1402, at the end of 2nd line. It is 200 yards northwest of M. H. Frankhouser's house, 50 yards west of county road and on northeast side of Pine Swamp. The Monument stands diagonally as the line turns to the east.

"Latitude 39° 33' 08.69". Longitude 79° 28' 44.85".

Monument No. 22.

"Is 53.69 feet eastward from Monument No. 21 in the same ravine, and about 100 feet west of the county road. It stands in the 2nd line of lot 1402 and is also on the property line between Frankhouser & Jenkins. The Monument stands diagonally as the boundary line turns northward again.

"Latitude 39° 33' 08.68". Longitude 79° 28' 44.16".

Monument No. 23.

"Is about 1 mile east of Cranesville, West Virginia, 80 feet north of county road from that place to Sang Run, Maryland. It is on a bank above a large spring and is on cleared land owned by J. G. Elsey, and is 50 yards north of house of E. F. Jenkins.

"Latitude 39° 33' 22.93". Longitude 79° 28' 44.03".

Elsey's Hill.

"A small monument on summit of flat cultivated ridge 1 mile east of Cranesville, on land owned by J. G. Elsey, and $\frac{1}{4}$ mile north of house of E. F. Jenkins.

"Latitude 39° 33' 34.93". Longitude 79° 28' 43.92".

Strawser Road.

"A small monument on north side of road from Cranesville, West Virginia, to Sang Run, Maryland, about $1\frac{1}{2}$ miles northeast of Cranesville and on land owned by Samuel A. Strawser.

Fike's Mountain (South Brow).

"A small monument on South Brow of Fike's Mountain, 2 miles northeast of Cranesville. It can be reached by a rough road through the woods.

Monument No. 24.

"On summit of Fike's Mountain $2\frac{1}{4}$ miles northeast of Cranesville, West Virginia. It can be reached by a rough trail through the woods from a wagon road which crosses the mountain $\frac{1}{2}$ mile west of Monument. The summit of the mountain is comparatively flat and no distant large monuments can be seen. The small monument on the south brow is visible as well as small monument on north brow.

"Latitude 39° 34' 49.21". Longitude 79° 28' 43.23".

Fike's Mountain (North Brow).

"A small monument on the north brow of Fike's Mountain, 1041.56 feet northward from Monument No. 24. It is $2\frac{1}{2}$ miles northeast of Cranesville, and $\frac{1}{2}$ mile northeast of county road, which crosses Fike's Mountain $\frac{3}{4}$ mile west of this point.

Monument No. 25.

"On a timbered flat ridge of White Rock Run near southeast corner of John A. Reckard's land and $\frac{1}{2}$ mile south of his house. It is in the woods 100 yards from private road from the Cranesville road to Reckard's house.

"Latitude 39° 36' 06.30". Longitude 79° 28' 42.51".

Reckard Road.

"A small monument 30 feet south of a second class road through the woods near house of John A. Reckard about 6 miles west of Friendsville, Maryland.

Herbert Friend's Ridge.

"A small monument on summit of flat ridge partly covered with timber and brush, owned by Herbert Friend, and is $\frac{1}{2}$ mile southeast of his house. It is 6 miles southwest of Friendsville.

Monument No. 26.

"On north side of county road from Keeler Glade to Friendsville and is 5 miles southwest of latter place. It is on land of Sherman Friend, about 100 yards northeast of his house.

"Latitude $39^{\circ} 37' 47.35''$. Longitude $79^{\circ} 28' 41.57''$.

Sherman Friend's Hill.

"A small monument on summit of a flat cleared hill, owned by Sherman Friend, who lives 300 yards to southwest. It is 5 miles southwest of Friendsville, Maryland.

Melville Friend's Hill.

"A small monument on summit of flat cleared hill owned by Melville G. Friend, who lives $5\frac{1}{2}$ miles west of Friendsville, Maryland, and 300 yards west of monument. A road crosses the hill 200 yards west of monument, and another is at foot of hill 300 yards to north of it.

Monument No. 27.

"On north side of county road near Mrs. Marshall Friend's house, about 5 miles west of Friendsville, Maryland. It is on south side of a cleared field bordering the county road and is on south property line of Mrs. Marshall Friend. It is in the Henry Deal surveys. The monument stands diagonally as boundary line has offset to east.

"Latitude $39^{\circ} 38' 32.37''$ Longitude $79^{\circ} 28' 41.16''$.

Monument No. 28.

"This monument is 347.3 feet eastward from Monument No. 27, and the same description applies to it. It also stands diagonally as boundary line here turns northward.

"Latitude $39^{\circ} 38' 32.40''$. Longitude $79^{\circ} 28' 36.72''$.

Monument No. 29.

"Is north of a wagon road through land of Jere Teets, and is about $\frac{1}{2}$ mile southeast of his house, and 5 miles west of Friendsville, Maryland.

"Latitude $39^{\circ} 38' 58.92''$. Longitude $79^{\circ} 28' 36.92''$

Jere Teets' Ridge.

"A small monument on a flat cultivated ridge sloping to the east, owned by Jere Teets, and is 150 yards east of his house, which is 5 miles west of Friendsville, Maryland. It is a few feet north of an east-west private road.

L. Dedrick's Ridge.

"A small monument on a flat, cleared ridge, owned by L. Dedrick, it can be reached from county road on the west by leaving that road near Chestnut Avenue Church and going eastward past house of Joshua Fike.

Monument No. 30.

"On summit of Evans Hill, 1 mile west of Fearer Postoffice, Maryland, and 150 yards south of the county road from Fearer to Chestnut Avenue Church. The monument is on cultivated land owned by Hosea Thomas, who lives 200 yards to the west.

"Latitude $39^{\circ} 40' 15.92''$. Longitude $79^{\circ} 28' 37.50''$.

Monument No. 31.

"On north side of county road from Friendsville, Md., to Hazelton, West Va., and is 1 mile west of Fearer, Md. It is 100 yards west of house of A. J. Thomas and on line dividing his property from that of Hosea Thomas.

"Latitude $39^{\circ} 40' 26.10''$. Longitude $79^{\circ} 28' 37.58''$.

Monument No. 32.

"Is $1\frac{1}{2}$ mile southeast of house of Geo. W. Vansickle, and is nearly the same distance southwest of W. M. Fike's house, and about 5 miles west of Selbysport, Maryland. The monument stands in place of a large Spanish Oak tree which was removed during the survey in 1911. This tree was corner of property of John Van Vansickle, George W. Vansickle, on the west, and in a line of W. Marshall Fike on the east. The land is cleared and the boundary line makes a slight deflection angle to the east. The monument is marked 'Span Oak' in addition to other inscriptions.

"Latitude $39^{\circ} 41' 14.28''$. Longitude $79^{\circ} 28' 37.94''$.

F. T. Fike's Ridge.

"A small monument in a field owned by F. T. Fike 200 yards east of a road leading from George Vansickle's place to Selbysport, Maryland.

Monument No. 33.

"On north side of county road leading towards Selbysport, Maryland, and is about 5 miles west of that place. It is on line between cleared land owned by James McDermott and Isaiah Umble.

"Latitude $39^{\circ} 42' 06.58''$. Longitude $79^{\circ} 28' 37.84''$

Thomas' Ridge.

"A small monument on cleared flat ridge owned by M. M. Thomas on the west and by Joseph Thomas on the east. It is 300 yards northwest of house of Joseph Thomas and $\frac{1}{2}$ mile south of Pennsylvania State Line.

Monument No. 34.

"At the intersection of the Md.-W. Va. boundary line from the south with the Pennsylvania state line. It is 2 miles southwest of Markleysburg, Pennsylvania, $\frac{1}{4}$ mile east of point where the pike to that place crosses the Penna. line, and $\frac{1}{4}$ mile northeast of house of M. M. Thomas. It is 1051 feet westward from the Mason & Dixon mound in which a stone monument marked, '55.2 M 1885,' was set by survey made in 1885 by the states of Pennsylvania and West Virginia.

"Monument 34 is 40 feet south of oil pipe line, which runs through Pennsylvania near its southern boundary, and is $\frac{1}{4}$ mile west of a metal gate house of this pipe line. It is in the straight line between Monuments of 1885 numbered 55.2 M and 54.2 M; the latter being 4276 feet to the westward and in center of a Mason & Dixon mound. The land south of Monument No. 34 is owned by M. M. Thomas. The monument sets square and is marked the same as others, excepting that on the north face are the letters P.A above the date 1910.

"Latitude $39^{\circ} 43' 15.88''$. Longitude $79^{\circ} 28' 37.72''$.

TABLE NO. 1.

Horizontal Distances from Monument No. 1—Distances Between Monuments,—True Bearings,—Magnetic Bearings and Approximate Elevations Above Mean Sea Level.

Monument Name or Number.	Horizontal Distances from Mon. No. 1.	Distances Between Monuments.	True Bearings.	Magnetic Bearings October 1, 1910.	Approximate Elevation Above Mean Sea Level.
	(Feet)	(Feet)	" " "	" " "	
Fairfax	3989.13	3989.13	S. 0 56 00 W.		3162 ft.
1	0000.00	1208.55	N. 0 56 00 E.		2721 "
2	1208.55	767.94	N. 0 47 53 E.	N. 4 40 E.	2894 "
Arnolds Ridge...	1976.49	9265.63	"	"	3103 "
3	11242.12	6664.26	"	"	3343 "
Stahlnaker Ridge	17906.38	3587.76	"	"	2778 "
4	21494.14	402.15	N. 71 48 00 W.		2480 "
5	21896.29	3655.65	N. 0 27 04 E.	N. 4 19 E.	2536 "
6	25551.94	4052.94	"	"	2523 "
Hamsteads Hill..	29604.88				2575 "

Table No. 1—Continued.

Monument Name or Number.	Horizontal Dis- tances from Mon. No. 1.	Distances Be- tween Monu- ments.	True Bearings.	Magnetic Bear- ings October 1, 1910.	Approximate Elevation Above Mean Sea Level.
	(Feet)	(Feet)	N. 0 27 04 E.	N. 4 19 E.	
7	33215.31	3610.43			2512 ft.
		587.40	"	"	
8	33802.71	1371.44	N. 0 42 57 E.	N. 4 38 E.	2535 "
Silas Fike Bolt in rock.....	35174.15				2568 "
		2650.09	"	"	
Dawson's Hill...	37824.24	3568.81	"	"	2548 "
9	41393.05	1391.72	"	"	2441 "
Offuts Hill.....	42784.77	5280.81	"	"	2558 "
Stahl's Hill.....	48065.58	2621.23	"	"	2707 "
10	50686.81	482.30	S. 89 17 03 E.	.....	2464 "
11	51169.11	2503.67	N. 0 41 02 E.	N. 4 42 E.	2444 "
12	53672.78	1188.10	"	"	2420 "
Ashby's Hill.....	54860.88	3321.20	"	"	2617 "
Lauer Hill Bolt in rock.....	58182.08	1386.99	"	"	2807 "
13	59569.07	7505.82	"	"	2857 "
Miller	67074.89	3042.91	"	"	2619 "
Poling	70117.80	5274.19	"	"	2634 "
White	75391.99	3047.23	"	"	2433 "
14	78439.22	2405.81	"	"	2470 "
Morris-Connell ..	80845.03	3536.24	"	"	2548 "
15	84381.27	4873.83	N. 0 22 27 E.	N. 4 34 E.	2587 "
Severe	89255.10	1713.46	"	"	2530 "
Browning	90968.56	7280.65	"	"	2622 "

Table No. 1—Continued.

Monument Name or Number.	Horizontal Dis- tances from Mon. No. 1.	Distances Be- tween Monu- ments.	True Bearings.	Magnetic Bear- ings October 1, 1910.	Approximate Elevation Above Mean Sea Level.
	(Feet)	(Feet)	° ' "	° ' "	
Burchinal road...	98249.21				2799 ft.
16	102635.31	4386.10	N. 0 22 27 E.	N. 4 34 E.	3020 "
17	106937.44	4302.13	"	"	3072 "
Teet's Road.....	116913.62	9976.18	"	"	2572 "
18	117867.00	953.38	"	"	2572 "
19	119430.97	1563.97	"	"	2572 "
20	120402.06	971.09	N. 89 27 27 E.	.....	2572 "
21	127955.42	7553.36	N. 0 17 00 E.	N. 4 29 E.	2575 "
22	128009.11	53.69	S. 89 43 00 E.	.....	2575 "
23	129450.93	1441.82	N. 0 24 42 E.	N. 4 48 E.	2630 "
Elsey's Hill.....	130664.63	1213.70	"	"	2788 "
Strawser Road...	133361.59	2696.96	"	"	2494 "
Fike's Hill— South brow...	137230.55	3868.96	"	"	2862 "
24	138181.57	951.02	"	"	2867 "
Fike's Hill— North brow...	139223.13	1041.56	"	"	2843 "
25	145983.20	6760.07	"	"	2582 "
Near Reckart road	150604.24	4621.04	"	"	2344 "
H. Friend.....	153138.74	2534.50	"	"	2379 "
26	156208.90	3070.16	"	"	2260 "
Friends Hill.....	156777.81	568.91	"	"	2331 "
M. O. Friend....	159773.78	2995.97	"	"	2299 "
		991.13	"	"	

Table No. 1—Continued.

Monument Name or Number.	Horizontal Dis- tances from Mon. No. 1.	Distances Be- tween Monu- ments.	True Bearings.	Magnetic Bear- ings October 1, 1910.	Approximate Elevation Above Mean Sea Level.
	(Feet)	(Feet)	° ' "	° ' "	
27	160764.91	347.31	N. 89 25 12 E.		2229 ft.
28	161112.22	2682.81	N. 0 20 07 W.	N. 4 10 E.	2221 "
29	163795.03	1493.04	"	"	2193 "
Jer. Teets.....	165288.07	2411.66	"	"	2282 "
L. Dedrick.....	167699.73	3887.49	"	"	2331 "
30	171587.22	1031.22	"	"	2399 "
31	172618.44	4874.95	"	"	2344 "
32	177493.39	3070.97	N. 0 04 55 E.	N. 4 38 E.	2337 "
F. T. Fike.....	180564.36	2221.59	"	"	2337 "
33	182785.95	4549.13	"	"	2289 "
Thomas	187335.08	2463.89	"	"	2301 "
34	189798.97				2321 "

TABLE NO. 2

"Magnetic Bearings Between Monuments on the Maryland-West Virginia Boundary Line from the Potomac River to the Pennsylvania line, for October, 1910.

"Note: The original observations were reduced at the office of the Coast and Geodetic Survey, Washington, D. C., by courtesy of the Superintendent of that Bureau.

Monument Nos.	True Bearing	Magnetic Bearing	Magnetic Declination	Number of Observations
2-4	N. 0° 47' 53" E.	N. 4° 40' E.	3° 52' W.	20
5-7	N. 0° 27' 04" E.	N. 4° 19' E.	3° 52' W.	7
8-10	N. 0° 42' 57" E.	N. 4° 38' E.	3° 55' W.	8
11-15	N. 0° 41' 02" E.	N. 4° 42' E.	4° 01' W.	6
15-18	N. 0° 22' 27" E.	N. 4° 34' E.	4° 12' W.	13
20-21	N. 0° 17' 00" E.	N. 4° 29' E.	4° 12' W.	2
23-27	N. 0° 24' 42" E.	N. 4° 48' E.	4° 23' W.	5
28-32	N. 0° 20' 07" W.	N. 4° 10' E.	4° 30' W.	5
32-34	N. 0° 04' 55" E.	N. 4° 38' E.	4° 33' W.	3

"If values for shorter intervals are desired, it will probably be best to obtain them by interpolating the declination. The value for the line between Nos. 20 and 21 is probably less reliable than the others, as it depends upon only two results which differ by 10'.

"We return herewith a financial statement showing in detail the money actually expended by the Commissioners for surveying and marking the boundary line under the decree in this case, including the per diem compensation of all the Commissioners. We also return herewith the several exceptions made and filed before the Commissioners by Mr. W. McCulloh Brown, one of the Commissioners, during the progress of the work, together with such explanations, observations and notes as we have thought proper to make concerning said exceptions for the information of the court.

"We also return herewith a number of photographs taken upon the ground illustrating the monuments erected by us to mark the line as run by us, showing the character of the work, method of construction and location of such monuments.

Respectfully submitted,

JULIUS K. MONROE,

SAMUEL S. GANNETT.

Commissioners.

"And this cause coming on this day to be heard upon said motion, and upon the said report of Julius K. Monroe and Samuel S. Gannett, and upon the separate report of W. McCulloh Brown, one of the said Commissioners, including his protest and exceptions in respect to said report of Commissioners Monroe and Gannett, and also upon the supplemental report filed by said Commissioners Monroe and Gannett; and the Court being now fully advised in the premises:

"It is thereupon adjudged, ordered and decreed that the said exceptions filed on behalf of the State of Maryland, as aforesaid, to said report of Commissioners Julius K. Monroe and Samuel S. Gannett, be, and they are, hereby overruled, and that said report be, and the same is, hereby in all respects confirmed.

"It is further adjudged, ordered and decreed that the line as delineated and set forth in said report of Commissioners Monroe and Gannett, and upon the map accompanying the same and referred to therein, which line has been marked with permanent monuments, as stated in said report, be, and the same is hereby, established, declared and decreed to be the true boundary line between the said States of Maryland and West Virginia, and said map is hereby directed to be filed as part of this decree.

"And it appearing that the total expenses and compensation of said Commissioners and the expenditures attending upon the discharge of their duties amount to the sum of \$17,154.60, it is further adjudged ordered and decreed that the same be, and they are, hereby approved and allowed as part of the costs of this suit, to be borne equally between the parties to this cause. And it appearing from said report that the State of Maryland has already paid \$5,038.40 of said amount and that the State of West Virginia has already paid \$12,116.11 of said amount, it is ordered that said amounts be credited to said States respectively in the settlement of the costs of this suit between them in accordance with the provisions of this decree and the former decrees entered herein.

"It is further adjudged ordered and decreed that the Clerk of this

Court do transmit to the chief magistrates of the States of Maryland and West Virginia copies of this decree, duly authenticated under the Seal of this Court, omitting from said copy, however, the map filed with the report of said Commissioners Monroe and Gannett above mentioned.

May 27, 1912.

"True copy.

"Test:

Clerk Supreme Court, U. S."

Preston county, which was originally contained in the District of Augusta and later in the County of Monongalia, was established by act of the General Assembly of Virginia, January 19, 1818. The creation of the county, as recorded in the Acts of Assembly, 1817-18, Chapter XXXII, page 32, is as follows¹:

"Be it enacted by the General Assembly, That all that part of the county of Monongalia contained within the following bounds to wit: beginning at the Pennsylvania line, near Fickle's, including the same, thence a straight line to where Cheat River breaks through the Laurel Hill, so as to include all the inhabitants of the Monongalia Glades settlement, including Samuel Price's and Henry Carother's, from thence, including Gandy's to the Clarksburg road on the Laurel Hill where it descends; from thence a direct line to the junction of the Big and the Little Sandy Creek, where the Randolph County line is; from thence, with Randolph County, to the Maryland line; from thence to the Pennsylvania line, and with the Pennsylvania line to the beginning, shall form a distinct and new county, and be called and known by the name of Preston County."

On February 29, 1828, the General Assembly of Virginia annexed a portion of Randolph to Preston county as follows²:

"That so much of the County of Randolph as lies within the boundary lines, towit: beginning at Lord Fairfax's stone, thence in a straight line to Grind-stone Spring on the Horse-shoe road; thence to Cheat River, where the line dividing Randolph and Preston counties crosses the same near James Goff's, shall be annexed to, and henceforth be a part of the County of Preston."

An additional portion of Randolph was annexed to Preston county by act of the General Assembly of Virginia, April 4, 1838, as follows³:

¹History of Preston County, S. T. Wiley, 1882, page 54.

²History of Preston County, S. T. Wiley, 1882, page 65.

³History of Preston County, S. T. Wiley, 1882, page 74.

"That so much of the County of Randolph as lies next to, and adjoining the County of Preston, and contained in the following boundaries, towit: Beginning at a point in the line which divides the County of Preston from the County of Randolph, on the western summit of the Alleghany mountain, as run and marked under the authority of the act passed February 29, 1828, as aforesaid, and running thence in a straight line to the mouth of Muddy Run on the east side of Cheat river, where the line dividing Preston and Randolph counties crosses said river, shall be annexed to and henceforth be a part of the County of Preston."

Another addition was made to the territory of Preston county three years later when, on petition of the residents, the General Assembly of Virginia transferred on March 15, 1841, a portion of Monongalia county, as follows⁴:

"That so much of the County of Monongalia as lies east of the ridge of mountains called Laurel Hill, and north of Cheat river, next to, and adjoining, the County of Preston, and is contained in the following boundary lines, towit: Beginning on the line dividing said counties at the point where it crosses Cheat river, and running thence a straight line to the England Ore bank, on top of the mountain; thence a straight line to the Osburn farm, so run as to include the dwelling house of said farm in the County of Preston; thence a due north course to the Pennsylvania line, shall be annexed to, and henceforth be a part of the County of Preston."

Preston county as thus formed was the thirty-fifth created by the Commonwealth of Virginia.

TRANSPORTATION.

Water Ways.

Cheat River.—Cheat river, which flows entirely across the county in a northwest direction, is the only stream with sufficient volume to be considered navigable. Its current is so swift, however, and its channel so rocky that United States Government Engineers have pronounced it unfit for any kind of boats except rafts that float downward with the stream, since the cost of building a sufficient number of locks to make navigation possible against the current would be prohibitive. In accordance with this decision the courts have ordered that all dams built across it shall be made passable only for rafts.

⁴History of Preston County, S. T. Wiley, 1882, page 92.

So far as known, the first attempt to determine the character of the river was an act by the State of Virginia described as follows by Wiley⁵:

"The board of public works, by act of Assembly passed on the 28th of February, 1837, were directed to have a survey made of Cheat River from the point at which the Northwestern Turnpike Road touched it, to the Pennsylvania line. The object of this survey was to ascertain the practicability of making a sluice navigation between these points."

No record is available to show whether these investigations were ever made.

Wiley described another attempt to establish navigation on Cheat river as follows⁶:

"On the 13th of March (1848), a Cheat River navigation company was incorporated, among the names of whose directors we find those of Elisha M. Hagans, Buckner Fairfax, Israel Baldwin and John Ambler. The board of directors was chosen from citizens of both Monongalia and Preston, but operations were never begun."

Cheat river has been used for many years for transporting log rafts to the saw mills of Pennsylvania. It was also used to transport pig iron from the furnaces near Ices Ferry in Monongalia county when these were in blast many years ago. The enormous dams now being built and projected for power purposes along the river make it extremely improbable that this stream will ever be used for steam navigation, except for pleasure parties.

Steam Railroads.

Baltimore and Ohio Railroad.—The main line of the Baltimore and Ohio Railroad crosses Preston county in an east and west direction, its length in the county being 32 miles. The construction of the road was begun in this county in 1850 and completed in 1852. As first built the road was a single track system, but the great development of coal traffic within late years has caused the company to make it a double track line entirely through the county and in many places even three and four tracks have been laid. Owing to the fact that the road

⁵History of Preston County, S. T. Wiley, 1882, page 71.

⁶History of Preston County, S. T. Wiley, 1882, page 95.

descends from the Alleghany mountains by heavy grades to the valley of Cheat river at Rowlesburg, the equipment contains many of the most advanced and powerful types of Mallet engines to be seen in the world.

Morgantown and Kingwood Railroad.—The Morgantown and Kingwood Railroad extends from Morgantown, Monongalia county, to Rowlesburg, Preston county, via Kingwood, a distance of 47.9 miles, of which 37.4 miles is in Preston county. The road was completed from Morgantown to Bretz in September, 1903; Bretz to Kingwood in March, 1906; and Kingwood to M. & K. Junction at Rowlesburg in July, 1907. It is a single track line with a traffic principally in lumber, coal, coke, glass sand, limestone, cement, and building stone.

West Virginia Northern Railroad.—The West Virginia Northern Railroad extends from Tunnelton on the Baltimore and Ohio system to Kingwood, a distance of less than 10 miles. The road does not connect with the Morgantown and Kingwood at the latter point but all freight between the two roads must be transferred in wagons a distance of one mile. This road, according to Henry Hanst, General Manager, was begun in 1884 and completed in 1887 as a narrow gauge under the name of the Kingwood Railway Company. The name was afterward changed to the Tunnelton, Kingwood & Fairchance Railroad and later to the West Virginia Northern Railroad. It was made standard gauge in 1894. Its traffic is principally in coal, which is carried to the Baltimore and Ohio Railroad at Tunnelton.

Kendall Lumber Company Railroad.—This railroad, which is the property of the Kendall Lumber Company and was formerly known as the Preston Railroad, extends from Hutton, Md., to Shafer in Tucker county, West Virginia, a distance of 19 miles. Most of the road is in Garrett county, Md., only a small part of it being in Preston county. A branch formerly extended from Crellin across the mountain to Aurora, but a large part of this branch has been abandoned owing to the exhaustion of the timber at Aurora. Its traffic is mainly in lumber.

Rowlesburg and Southern Railroad.—The Rowlesburg and Southern Railroad, which is a feeder for the Baltimore and Ohio at Rowlesburg, extends up Cheat river to Erwin at the

mouth of Wolf creek and from there is being constructed up Wolf creek. It is 9 miles long and is used for hauling lumber.

Lumber Railroads.—In addition to the railroads described above, a number of temporary roads have been built in the county, some of which are still in operation. They have all been built for removing timber and have been abandoned usually as soon as the timber supply was exhausted. The Cheat river canyon is now the center of lumber operations in the county and along its steep slopes several lumber roads have been built.

Highways.

Indian Trails.—The first lines of communication across Preston county were the Indian trails. It is worthy of note that while these paths were developed by the Indians without the aid of science or engineering equipment, many of them were so well located that the road builders of a later epoch could do little more than widen them, thus paying tribute to the unconscious topographic instinct of the natives. Samuel T. Wiley, in his "History of Preston County," pages 17-18, gives a valuable account of these trails as follows:

"The Great War-Path running from the Ohio to the South Branch (of the Potomac) entered Preston from Monongalia, passed through the McMillen farm, by Masontown, then through Thomas Watson's farm, and north of Reedsville, running in some places with the present Morgantown and Kingwood turnpike; then north of Kingwood and crossing Cheat River at the Dunkard Bottom, kept down that stream a couple of miles, and crossed the mountain, passing between Willey P. O. and Portland, and left the county in the vicinity of Cranesville, where it entered Maryland.

"**Southern Branch.**—Between Masontown and Reedsville this branch left the great war-path, passing by Gladesville, and crossing between Independence and Newburg, followed York's Run, leaving it near its mouth at the Coffin Rock, kept south of Evansville, coming into the northwest trail at Ice's mill on Big Sandy.

"**North-West Trail.**—This trail was a path that entered the county from Maryland, near Mt. Carmel, and keeping pretty much along the ridges, crossed Cheat River near the bridge at Deakin's, then keeping with the Northwestern Turnpike in its ascent of the mountain, left it about a half mile east of William H. Brown's; and passing through Chalmber's Glenn farm by the Indian Foot Rock, on which were cut pictures of birds and beasts and a large number of feet. It ran here with the old Clarksburg road, and keeping south of Fellowsville and Evansville to Ice's mill on Big Sandy, where it was joined by the Southern Branch.

"Northern Trail.—This trail entered the county from the Murley glades in Maryland, came north of Cranesville, through the Crab Orchard, passed near Jehu Jenkins's and Joseph N. Miller's and through the Metzler farm, crossing Little Sandy, and then Big Sandy near Bruceton, and keeping north of Wymps Gap, then through it to Cheat, and leading into the vicinity of Morgantown."

Northwestern Turnpike.—Yielding to a demand from the citizens of Preston and other counties, the General Assembly of Virginia, on February 27, 1827, incorporated the Northwestern Road Company to build a road from Winchester to some proper point on the Ohio river between the mouths of the Muskingum and Little Kanawha rivers. The road was capitalized at \$75,000 and was to be built by stock subscriptions secured from the principal towns along its course. The enterprise was regarded with high favor at Kingwood until the locating engineers had declared that the proposed route through Kingwood was not feasible but that the road must be built through the southern part of the county. This report made it impossible to secure large subscriptions at Kingwood and for that reason the enterprise failed.

In 1831 the State of Virginia, by act of the General Assembly, made the road a public enterprise by assuming its construction under the name of "The North-Western Turnpike Road". The road as thus established had a maximum grade of five degrees, maximum width of 18 feet, and minimum width of 12 feet. It was completed in 1838 and at once became the principal route across the Alleghany mountains, the traffic over it being immense. Its route through Preston county may be traced on Maps I, II and III in the separate atlas with this report. The road, as originally built, was macadamized at only a few localities. This macadam has been but imperfectly preserved and it can be classed only as a dirt road. The completion of the Baltimore and Ohio Railroad through Preston county in 1852 took all the heavy through freight traffic off the pike but it is still an important line of communication and owing to the magnificent mountain scenery through which it passes is a favorite route for automobile travel.

Brandonville and Fishing Creek Turnpike.—The Brandonville and Fishing Creek Turnpike is a dirt road extending from the West Virginia-Maryland state line via Brandonville, Bruceton, Pisgah and Morgantown to Fairmont. It was orig-

inally authorized by the General Assembly of Virginia in 1830 as a company road to be built by stock subscriptions, but this plan was abandoned and the road was completed by the state in 1838.

Morgantown and Kingwood Turnpike.—The Morgantown and Kingwood Turnpike, as it is now known, is a part of a road that was originally established by the State of Virginia between Morgantown, Monongalia county, and Aurora, Preston county, via Reedsville, Kingwood and Terra Alta. In 1851 the sum of \$2800.00 was appropriated to macadamize the road between Morgantown and Terra Alta. This money must have been spent only on the worst portions of the road as the sum was not enough to improve the entire road. No trace of the macadam exists now. The road between Morgantown and Kingwood is located for the most part along high sandy ridges where there is little mud.

Morgantown and Beverly Turnpike.—The Morgantown and Beverly Turnpike, which was originally chartered in 1837 by the State of Virginia under the name of the "Pennsylvania, Beverly and Morgantown Turnpike", extends from the Pennsylvania line through Morgantown, Ridgedale, Gladesville, Independence, Evansville and Dent to Beverly, Randolph county. The date of completion is not known but it was subsequent to 1853 when the charter of the road was renewed. This highway is only a dirt road, but can be traveled with ease during most of the year.

Tunnelton and Ices Ferry Turnpike.—The Tunnelton and Ices Ferry Turnpike extends from Tunnelton, Preston county, via Oriole, Browns Mills, Reedsville, Masontown and Rohr to Ices Ferry in Monongalia county. No record is available to show when it was built. It is a dirt road, but like nearly all the roads of Preston county is in sandy soil and comparatively free from mud.

Kingwood and Brandonville Turnpike.—The Kingwood and Brandonville Turnpike, as it is now known, was established by act of the General Assembly of Virginia, April 7, 1838, under the name of the "Brandonville, Kingwood and Evansville Turnpike", the intention being to build a road between the Brandonville and Fishing Creek Turnpike and the Northwestern Turnpike. No attempt was made to build it as

a private enterprise as this method had failed often enough to show that it was not practicable. It is a dirt road, crossing Cheat river at Albright and passing through Valley Point.

Kingwood and Terra Alta Turnpike.—The Kingwood and Terra Alta Turnpike is a portion of a road that was formerly known as the "Morgantown, Kingwood and West Union (Aurora) Turnpike". It is a dirt road between Kingwood and Terra Alta, crossing Cheat river at Fairfax Ferry and ascending the Briery mountains by an easy grade.

Aurora and Terra Alta Turnpike.—The Aurora and Terra Alta Turnpike is another portion of the old Morgantown, Kingwood and West Union Turnpike. It is a dirt road between Aurora and Terra Alta, passing through Amboy. The road is built on a higher average elevation than any other turnpike in the county, ranging from 2400' to 2800' above sea level.

Ordinary County Roads.—According to A. D. Williams, State Road Engineer, the total mileage of all public roads in Preston county is 1200. This figure includes the turnpikes described above. The roads of the county are as well kept as those of the average county in the northern part of West Virginia, but the unusually great topographic relief makes them necessarily steep and difficult to travel.

GENERAL DESCRIPTION.

Miscellaneous Items.

Area.—The area of Preston county as determined by planimeter from the topographic sheets of the United States Geological Survey is as follows:

Districts.	Sq. Miles.
Grant	96.13
Pleasant	87.20
Valley	61.23
Lyon	42.72
Kingwood	57.85
Portland	110.85
Reno	97.62
Union	100.28
Total for county.....	653.88

Relief.—The surface of Preston county varies in elevation from 875' above sea level, the elevation of Cheat river at the Beaverhole next to the Monongalia line, to 3380', the elevation of the highest point on Backbone Mountain in the southeast corner of Union district near the Maryland State line. This makes a maximum variation of 2505', or almost one-half mile. The southeastern part of the county, including Portland, Reno and Union districts, is a mountain region with summits ranging from 2500' to 3300' in elevation. The remainder of the county to the northwest, including Grant, Pleasant, Valley, Lyon and Kingwood districts, is in the foot hills region with summits ranging generally from 1500' to 2300'. A comparison of these two regions shows that there is an average difference of 1000', making a very perceptible variation in climatic conditions.

Population.—The following table, taken from the U. S. Census returns for 1910 shows the population of Preston county by magisterial districts for the last three enumerations:

Population of Preston County.

Districts.	1910	1900	1890
Grant district, including Brandonville and Bruce-			
ton towns	2,123	2,096	2,192
Brandonville town	96	68	82
Bruce-ton town	116	80	.....
Kingwood district, including Kingwood town and			
part of Tunnelton town.....	3,938	3,033	2,315
Kingwood town	800	700	.....
Tunnelton town (part of).....	470	479	.....
Total for Tunnelton town ¹ in Kingwood and Reno			
districts	792	479	.....
Lyon district, including Newburg town.....	3,244	2,943	3,363
Newburg town	823	751	778
Pleasant district	1,940	1,788	1,891
Portland district, including Tera Alta town.....	4,698	4,145	3,264
Terra Alta town	1,126	616	443
Reno district, including Rowlesburg town and part			
of Tunnelton town.....	4,510	4,136	3,565
Rowlesburg town	936	652	560
Tunnelton town (part of) (returned in 1900 as in			
Kingwood district only).....	322	.....	.....
Union district	2,725	2,806	2,135
Valley district, including Masontown town and			
Reedsville village	3,163	1,780	1,629
Masontown town (incorporated in 1905).....	520	.....	.....
Reedsville village (incorporated in 1906).....	208	.....	.....
Total for county.....	26,341	22,727	20,355

¹Returned in 1900 as Kingwood district only.

The above figures show that Preston county has had a steady growth during the last twenty years; the percentage of increase from 1890 to 1900 was 11.7, while from 1900 to 1910 it was 15.9. This growth is not as great as that in the State or Nation, the increase for West Virginia from 1900 to 1910 being 27.4 per cent, while the increase for the entire United States was 21 per cent. In 1910 the density of population for Preston county was 40.2 inhabitants per square mile. In the same year the density for West Virginia was 49.9, while for continental United States it was 30.4. The entire population of Preston county is classed as rural by the Census Department, there being no town within its boundaries of 2500 or more inhabitants.

Products.—The principal animal products of Preston county are horses, cattle, poultry, sheep and hogs, their value being in the order named.

The principal vegetable products are hay, corn, oats, buckwheat, wheat, apples and potatoes. The soil of the county is especially adapted to the culture of buckwheat and potatoes. Experts declare that there is no better potato land in the world.

The principal mineral and manufactured products are coal, coke, building stone, Portland cement, brick, and glass sand. The water power resources of the county are large and plans are already made to develop a large amount of hydro-electric power in the near future.

Property Valuation.—The State Auditor gives the following property valuation for Preston county for the three years ending with 1912:

	1910	1911	1912
Real Estate	\$12,669,638	\$12,707,372	\$13,018,805
Personal Property	3,840,966	4,043,670	4,124,906
Totals	\$16,510,604	\$16,751,042	\$17,143,711

According to the above figures, Preston county ranks fourteenth in the State in point of wealth.

Postal Service.—The reorganization of the post-office department and the establishment of rural free delivery routes have caused many of the smaller post-offices of the county to be abandoned. The following table, supplied by H. S. Whetsell, postmaster at Kingwood, shows the post-offices and rural

routes now (May 15, 1913) in existence in the county. These rural routes are supplementary to the railway mail service:

Preston County Post-Offices.

Post-Office	Number of R. F. D. Routes	Post-Office	Number of R. F. D. Routes
Albright	2	Glade Farms.....	..
Amblersburg	..	Horseshoe Run.....	..
Amboy	..	Howesville	..
Anderson	..	Hudson	..
Aurora	1	Independence	2
Austen	..	Kingwood	2
Brandonville	1	Manheim	..
Breedlove	..	Marquess	..
Bretz	..	Masontown	1
Bruceton Mills.....	1	Newburg	3
Caldwell	..	Pisgah	..
Cascade	..	Reedsville	1
Cherry Grove.....	..	Rockville	..
Clifton Mills.....	1	Rodemer	..
Colebank	..	Rowlesburg	1
Corinth	..	Sinclair	..
Cranesville	..	Terra Alta.....	2
Cuzzart	..	Tunnelton	3
Eglon	..	Valley Point.....	..
Erwin	..	Whetsell	..

From the above table it will be seen that Preston county has 40 post-offices and 21 rural free delivery routes.

Towns and Industries.

There are nine incorporated towns in Preston county. Of these only one has a population exceeding 1000 persons. Little attempt has been made to develop manufacturing industries in any of them, mercantile, mining and railroad pursuits being the chief source of income for the inhabitants. Their detailed description follows:

Kingwood.

Kingwood, the county seat of Preston county, is located along the Morgantown & Kingwood Railroad on a high ridge

terrace at an average elevation of 1850' above sea level. Its elevation of 200' or more above the valleys makes its climate both pleasant and healthful. The population by the census of 1910 was 800, an increase of 100 over that of 1900.

The first record of a settlement at Kingwood is given in the following quotation from Wiley's history⁷:

"Conrad Sheets, Jacob Funk, and a man by the name of Steele, in 1807, built houses upon the site of Kingwood and named the place Kingwood, from the grove of large and stately trees which stood round an emigrant camping-place, where the Court-house now stands. This body of timber was known by the emigrants as the 'King-wood,' or grove of 'King-trees.'"

Regarding the establishment of the town, Wiley gives the following⁸:

"Kingwood was established as a town of Monongalia county, Virginia, on the 23rd of January, 1811, and was the first town established in the territory of Preston. On the 12th of March, 1853, it was made a town corporate by the name of 'The Town of Kingwood.' The officers were to consist of seven trustees and a sergeant. James C. McGrew, William G. Brown, and Israel Baldwin, or any two of them, were appointed to hold the first election on the first Monday in June, 1853. The following board was elected and organized June 7, 1854: E. T. Brandon (president), John H. Bennett, Henry Startzman, Peter Barrick, John J. Brown; Edward C. Bunker, secretary."

Kingwood is the county seat of Preston county, and for that reason has long been more prominent than the other towns of the county. It is the supply point for a considerable farming region and also for several mining villages in the neighborhood. An extensive industry in building stone, that will be described fully in Chapter XIV, is located on the outskirts of the town.

The county court-house was burned March 7, 1869, and all the public records were destroyed.

Kingwood Manufacturing Company.—Just opposite the Morgantown & Kingwood Railroad station is located the plant of the Kingwood Manufacturing Company. This concern, with head office and works at Kingwood, manufactures concrete blocks, cement bricks and concrete steps. According to George A. Herring, Superintendent, the daily capacity is 1,000 blocks or 10,000 bricks, but the output is only 800 blocks or 8,000 bricks. Seven men are employed with a weekly pay roll of \$60 to \$75. For aggregate, local sandstone and sand secured

⁷History of Preston County, S. T. Wiley, 1882, page 50.

⁸History of Preston County, S. T. Wiley, 1882, page 460.

partly from the Sturgisson crusher and partly from Cheat river at Point Marion, Pa., are used. The Portland cement used is made at Manheim, Preston county. The equipment includes a Velten Universal rock crusher and a Helm concrete block machine. The bricks, which require no burning, have a gray color.

Terra Alta.

Terra Alta, which is the largest town in Preston county, is located on the Baltimore and Ohio Railroad at the summit of a high divide between the waters of Cheat and Youghiogheny rivers. The elevation of the railroad is 2549' above sea level, while the town reaches to a considerably higher level on the mountain slopes to the north and south. This high elevation makes the climate so invigorating and delightful that the town has long enjoyed a reputation as a summer resort. The population, in 1890, was only 443; while in 1900 it had grown to 616, but in 1910 it had increased to 1,126, making an increase of 154 per cent in twenty years.

Terra Alta, since its first settlement has had several names. The following account, from Wiley's history⁹, gives valuable information regarding the early history of the town:

"Cranberry is situated at the junction of the Cranberry and Brandonville with the Kingwood and West Union turnpikes, on the B. & O. R. R., 137 miles east of Wheeling, 64 miles west of Cumberland, and 10 miles southeast of the county-seat. At the head of the celebrated 'Green Glades' and the Salt Lick valley, it is 2500 feet above tide level. It was first Salt Lick Falls P. O., then Cranberry, after the name of the railroad station, which was Cranberry Summit, because of the cranberry swamps, and the place being situated on the summit of the Laurel Hill range.

"Somewhere about 1858, Eastern men, mostly from Maine, came in and made it a center of the shook trade in the State, and in honor of the metropolis of Maine, called it Portland.

"In 1869, when Cranberry was a candidate for the county-seat, and before it had been decided to rebuild the court-house at Kingwood, ex-Senator Jones, in an earnest speech setting forth its advantages called it 'The Commercial Center,' an apt appellation that has become almost another name of the town. Owing to the confusion caused by there being several Portlands in the Union, the council of the town decided to have the name changed to Cranberry, which was done by an act of the legislature passed January 19, 1882, which took effect April 20, following. The name of the post-office was changed to Cranberry two or three years before.

"Cranberry was incorporated by the name of Portland on the

⁹History of Preston County, S. T. Wiley, 1882, page 410.



PLATE III.—State Tuberculosis Sanitarium, one mile east of Terra Alta.

Photo by E. E. Knight

13th of March, 1860. The officers of the town were to be seven trustees and a sergeant, they composing the council. * * * * *

"The first post-office established was Salt Lick Falls, James C. McGrew, P. M.; then Cranberry, Elijah E. Alford, P. M.; and in 1860, Portland, and Wm. B. Crane, P. M., succeeded by John P. Jones."

The name of the town was changed to Terra Alta August 6th, 1890.

The town owes its growth largely to the great increase of freight traffic on the Baltimore and Ohio railroad, the development of the farming and fruit industries in the neighborhood, and to its reputation as a healthful summer resort. One mile east of the town an artificial lake, nearly a mile long, has been made by building a dam across the north branch of Snowy creek, which, with its accompanying hotel and pleasure grounds, makes an interesting resort.

State Tuberculosis Sanitarium.—The State Board of Control, acting under authority of the Legislature of 1911, located a State Tuberculosis Sanitarium at Hopemont, 1½ miles east of Terra Alta. The institution is designed to furnish treatment for citizens of the State who are afflicted with tuberculosis. The portion of the act of the Legislature which defines the purpose of the institution is as follows:

"Sec. 3. There shall be admitted into said sanitarium residents of this State who may be suffering with tuberculosis, which persons shall be divided into two classes, namely: **First.** Those unable to pay the expenses of their care and treatment. **Second,** Those who are able to pay and shall pay the same. The reasonable expenses of poor persons admitted at the request of the authorities of any municipal corporation or county shall be paid by such municipal corporation or county. Regulations may be made to receive persons who are able to pay part but not able to pay all of the expenses of their care and treatment. Schedules of rates to be paid by patients shall be made by the State Board of Control."

Concerning the grounds and buildings the Board of Control reports the following¹⁰:

"The farm is 535.78 acres in extent, and is located on the top of the great Cheat Mountain Range, with altitude ranging from about 2,500 feet at the lowest point to 3,000 feet above sea level at the highest point. A portion of this farm is made up of hills gradually sloping back from the level portions with such diversity of exposures as to afford building ground fronting in any direction that may be best suited to such an institution.

¹⁰W. Va. State Board of Control, Vol. II, Part I, 1912; pages 317-318.

"Nearly one-half of this tract of land is very fertile level glade land. We had it examined by Mr. J. H. Arnold, a representative of the United States Department of Agriculture, who informs us that this glade land is a very high grade trucking land and well suited to the uses of the sanitarium. A practical farmer has been employed and during the past season has been engaged in cultivating the land.

"Two large and never-failing streams of water flow through the farm—one the north fork of Snowy creek, being the outlet of Lake Terra Alta, and the other the Southern Branch of Snowy creek. In addition to this we have secured for hospital use a supply of good pure water from several mountain springs, which we bring to the buildings by two lines of galvanized pipe. The elevations of the springs are such as to afford a reasonably good water pressure in the buildings. * * * * *

"Receiving Building.—This building has a frontage of 163 feet, and consists of a two-story central part 29x56, and two one-story wings each 67x23 feet. On the first floor of the central part are the dining room, offices, kitchen, pantry and cold storage room. On the second floor are the living apartments for the superintendent and attendants.

"The two wings are identical, one being a ward for women, the other for men, and the rooms are so arranged that they may be thrown open or closed as weather requires.

"The capacity of this building is 20 patients, with quarters for superintendents and attendants.

"Cottage No. 1.—This is a one-story structure, 137x26 feet, with an extension in the rear of the center 28x25 feet.

"A wide open porch extends along the entire front of the building, and the rooms of the patients open out on this porch. The patients are expected to stay on this porch except in extremely cold weather. In the rear extension are located bath rooms and lavatories.

"The capacity of this building is 20 patients.

"Cottage No. 2.—This cottage is identical in size and arrangement with Cottage No. 1.

"These cottages are fitted up with sash which in ordinary weather will be kept up so as to open the front to the entire height of the room, and which in very severe weather may be lowered for protection.

"One of the cottages will be used for female patients, and the other for males."

Alpine Mills.—The Alpine Mills, with its head office and works at Terra Alta, was established in 1904. According to A. J. Elliott, proprietor, the output consists of wheat and buckwheat flour and oats and corn products. The mill has a capacity of manufacturing 60 barrels of wheat flour and 110 barrels of buckwheat flour daily, and oats and corn products of 2,000 bushels each monthly. A special breakfast food known as "Porridge Meal" is manufactured from wheat. The buckwheat used is grown in Preston county and in the neighboring States of Pennsylvania and Maryland, the Pennsylvania buckwheat being considered much inferior to that of Preston county or

Maryland. Besides supplying a large local trade, buckwheat flour is shipped from this mill to every State in the Union.

Rowlesburg.

Rowlesburg is located at the point where the Baltimore and Ohio Railroad crosses Cheat river. Since it is also the eastern terminus of the Morgantown and Kingwood Railroad and the northern terminus of the Rowlesburg and Southern, it is, by far, the most important railroad point in the county. The Baltimore and Ohio has extensive yards here to handle the large number of extra engines that are constantly needed to haul freight up the steep mountain grades to the east and west that are made necessary by the steep descent to the Cheat river crossing.

In 1890 the population of Rowlesburg was 560; in 1900 it was 652, but in 1910 it had grown to 936, making it the second largest town in the county.

Concerning the early history of Rowlesburg, Wiley gives the following¹¹:

"Rowlesburg is 75 miles west of Cumberland, and 126 miles east of Wheeling, on the B. & O. R. R., and is situated on the west side of Cheat river, where that stream cuts its way deep down through Laurel Hill Ridge, leaving lofty mountains encircling the town below. It stands on lands patented by James Goff in 1793, which passed into the possession of his son, Salathiel, who had a cabin on J. M. Senseman's garden on C. M. Bishop's land. It is asserted that John Wheeler had a cabin here before Goff. The first house was built on the river bank by the railroad company for Rowles, by one account, but Squire H. H. Wheeler, who was here in January, 1850, says it was built by Daniel Loudon. It was moved opposite the post-office, and is now occupied by W. W. Shoch. Rowlesburg was named after Thomas Rowles, a division engineer of the B. & O. R. R., and was incorporated February 27, 1858. The first town council was Wm. Hall (mayor), A. L. Hooton, T. F. Head, H. H. Wheeler, and Alonzo Henry, with a Recorder whose name is unknown."

Rowlesburg owes its prosperity principally to the railroads that enter it. In addition to these there is a large stone quarry, that will be described in Chapter XIV, located in the town, and a large cement mill that will be described in Chapter XIII, located at Manheim, 2 miles northwest of the town.

¹¹History of Preston County, S. T. Wiley, 1882, page 512.

Newburg.

Newburg is located on the Baltimore and Ohio Railroad, in the western part of the county, $2\frac{1}{2}$ miles from the Taylor county line. It was incorporated by act of the Legislature, February 12, 1868, with a municipal government composed of a mayor, recorder and five councilmen. In 1890 the population was 778; in 1900 it had decreased to 751, but in 1910 it was 823. The citizens are occupied chiefly in railroading, mining and mercantile pursuits. A large coal mine, that will be described in Chapter XII, is located in the town and contributes to its prosperity.

Tunnelton.

Tunnelton is located on the Baltimore and Ohio Railroad, partly in Kingwood and partly in Lyon district. It is also the southern terminus of the West Virginia Northern Railroad. The town owes its name and existence to the fact that it is situated at the east portal of the great Kingwood tunnel of the Baltimore and Ohio Railroad. This tunnel, which was completed in 1852, is described as follows by Wiley¹²:

"Lemon, Gorham, Clark and McMahon had the contract for making this tunnel. In its making was employed a small army of Irishmen armed with carts, wheelbarrows, shovels, picks, crowbars and drills. A deep excavation was made at each end and rapidly worked, while three shafts were sunk from the top of the hill. The shafts were 15 by 20 feet at the top, and were sunk 180 feet. Two locomotives were brought upon the ground, and used to carry iron, rails and all kinds of materials needed, over the top of the hill. They were run up on a temporary track laid at the remarkable grade of 500 feet to the mile. It required two years and eight months to make the tunnel. It is 4106 feet in length, and was cut through a compact slate, partly overlaid by a limestone roof. It was afterward arched with brick, on account of the roof being unsafe. At the time of its completion, it was the longest tunnel in North America, and one of the greatest engineering triumphs of that day. When completed and measured, it was found that 200,000 cubic yards of earth and rock had been removed, 110,000 yards from the outside, and 90,000 yards from the inside."

This tunnel, as first built, was single track, but the company has completed a second tunnel, situated a few rods south of and at a slightly lower level than the old one. The new

¹²History of Preston County, S. T. Wiley, 1882, page 111.

tunnel is double track and high enough to accommodate the great engines that are now being used. This tunnel was begun September 16, 1910, and completed in March, 1912, being 4,211 feet long.

The population of Tunnelton in 1900 was 479, but in 1910 it was 792. The post-office was established in 1852, but the town was not incorporated until 1897. In addition to the railroad occupations in which many of its citizens engage, the town is the center of a flourishing mining industry and is also the supply point for a considerable rural community.

Masontown.

Masontown is situated on the Morgantown and Kingwood Railroad, in the western part of Preston county, two miles from the Monongalia county line. The town was named after William Mason, who settled here in 1856. It was not incorporated until 1905. The population in 1910 was 520. Coal mining is the chief industry, a large mine being located directly beneath the town. It is located in a prosperous farming community and is therefore a good mercantile point.

Reedsville.

Reedsville is situated on the Morgantown and Kingwood Railroad, in the western part of the county, 3½ miles, air line measure, from the Monongalia county line. It was named after James Reed, who settled there in 1827. It was not until 1856 that the first store was built and the place was given this name. It was incorporated as a town in 1906. The population in 1910 was 208. Reedsville is in the center of what is perhaps the best farming region in Preston county, and from this source has derived its growth.

Bruceton.

Bruceton (Bruceton Mills post-office) is located on Big Sandy creek along the Brandonville and Fishing Creek turn-pike. Concerning its early history Wiley says the following¹¹:

¹¹History of Preston County, S. T. Wiley, 1882. page 35.

"At the junction of the Brandonville, Kingwood and Evansville Turnpike with the road from the Ohio, by way of Morgantown, to Brandonville, on Big Sandy creek, near Morton's mill, two or three houses stood at the time these turnpikes were projected; and, in connection with the mill, went by the name of Milford. In 1847, John Hoffman came into possession of the mill and houses, and laid out a town—the sixth in the county—naming it Bruceton in honor of his step-father, George Bruce, of Maryland."

Bruceton was incorporated by act of the General Assembly of Virginia, March 28, 1853, and commissioners were appointed to make a plan of the town to record in the office of the county court. In 1900 the population was 80, and in 1910 it was 116. In 1913 the postmaster reports 142 inhabitants by actual count. In addition to the farming and mercantile pursuits of its inhabitants the town has a prosperous flour mill that has engaged extensively in the manufacture of flour from both wheat and buckwheat.

Brandonville.

Brandonville is located one mile northeast of Bruceton, and is at an elevation of about 1800 feet above sea level and 250 feet above Big Sandy creek. It was incorporated by act of the General Assembly of Virginia, February 24, 1858. The population in 1890 was 82; in 1900 it had decreased to 68, but in 1910 it was 96. In 1843 the Assembly established a school for the instruction of the youth of the village under the title of the "Brandon Academy." The building still stands, but is no longer used as an institution of learning. Brandonville shares with Bruceton the local trade of a large farming community.

Villages.

The following table gives a list of the unincorporated villages of the county, with their respective populations. Small settlements, containing only a few persons, are not given. Those which are mining towns are given in black face type:

Village.	Population	Village.	Population
Albright (including St. Joe).....	300(A)	Gladesville	125(R)
Amblersburg	36(A)	Guseman	43(A)
Aurora	150(E)	Hazelton	38(A)
Austen	297(R)	Hiorra	300(E)
Bretz	260(E)	Holmes	25(E)
Burk	150(E)	Howesville	200(A)
Cascade	167(R)	Independence	325(R)
Clifton Mills.....	90(R)	Irona	50(E)
Corinth	300(E)	Lenox	16(A)
Cranesville	66(A)	Manheim	450(E)
Denver	185(A)	Pisgah	45(R)
Egdon	100(E)	Rockville	12(A)
Erwin	171(A)	Rodemer	25(E)
Evansville	56(A)	Valleypoint	25(E)
Fellowsville	75(A)	Zevely	150(E)

A.—Actual count by postmaster or other responsible person in 1913.

E.—Estimate by postmaster or other responsible person in 1913

R.—Rand-McNally Shippers' Guide, population for 1910.

At the village of Guseman is located the factory of the **Englehart Woolen Mill Company**. According to J. M. Englehart, manager, the head office of the firm is located at Albright, R. F. D. No. 2. The mill was established in 1846 by John W. Rigg, but was incorporated under the title named above in 1904. The company manufactures woolen goods, mostly flannels, the capacity being 120,000 pounds yearly. The equipment includes a 2 set mill containing 12 broad looms with 960 spindles. There are 22 skilled laborers employed, of which 20 are men and 2 are boys. The factory is in operation the entire year, with a monthly pay roll of \$1,000 and yearly business of \$72,000. The product is hauled by wagon to Albright, six miles distant.

CHAPTER II.

PHYSIOGRAPHY.

PHYSIOGRAPHIC CHANGES.

The present land forms of Preston county are the results of many complex forces that have acted through successive ages of geological history. Since the surface rocks of the county consist of stratified layers of sandstone, shale, limestone and coal, and since these various layers, with the exception of the coal, were formed under a considerable depth of water, the conclusion is evident that the surface was once a comparatively level plain. The present forms show that many changes have taken place since this ancient level condition prevailed. In a large portion of the county the stratified rocks are not in a horizontal position, but have been warped into great arches and troughs, being, in many cases, elevated to heights that are hundreds and sometimes thousands of feet above their original condition. In these regions of great structural change, as well as in the places where the strata are still comparatively level, the surface has been remarkably disfigured and cut into great hollows by the action of external forces.

The folding of the strata is the visible result of forces that have acted beneath the surface. Comprehensive studies of earth history have shown that the earth was originally a mass of hot matter and that it is gradually undergoing a cooling process. Since this cooling has taken place more rapidly at the surface than in the interior of the earth, and since contraction nearly always accompanies cooling, great lateral forces have been developed by this unequal cooling and the crust of the earth has been drawn together in immense wrinkles that have disturbed the previously level condition of the stratified rocks and formed the mountains.

Since the surface rocks are always subject to the erosive action of water and other agencies, it is apparent that at the same time the mountains were being formed they were also being graded down at their summits. Previous geological study has shown that the first folding which formed the Appalachian System, in which Preston county is situated, took place in the Permian period. There are no rocks of this type now left in the county, but as they are still found in Garrett and Allegany counties, Maryland, east of the mountains, and in Monongalia and other counties of West Virginia, west of the mountains, it is reasonable to suppose that a portion, at least, of the Permian rocks once existed in Preston county previous to the formation of the mountains. If it is assumed that only a nominal thickness of the Permian rocks covered the county a restoration of all the intervening rocks down to those which now crown the summits of southern Preston would, in many places, give the mountains a height of more than 6,000 feet above sea level. Since erosive action took place at the same time as the lateral folding, it would be mere conjecture to say what height the mountains reached.

The erosive work of the mountain streams, begun in the Permian Period, continued through many thousands of years until, in the Cretaceous Period, the Appalachian summits had reached an almost level, or peneplain, condition.

During this same period lateral forces again became active and raised the Cretaceous peneplain into a second mountain system, exposing still deeper formations of the rock column.

This second system of mountains was attacked by the rains of the late Cretaceous and early Tertiary Periods and was brought again, in the latter period, to a second peneplain.

Late in the Tertiary Period another series of foldings created a third range of mountains located in the same region as the two previous ones. It is this third range that forms the Appalachian system of the present day. The present geological period being one of erosion, the mountains, for a third time, are wearing down to a lower level.

The geological events just related have combined to make the Preston county region one of great complexity, both in surface appearance and in the lay of the rock strata. The southeastern portion of it, especially, shows the effect of these events

to a marked degree, the rocks being much tilted toward the vertical and the mountains being lofty and precipitous. In the western portion the strata are more nearly horizontal and erosion has left a much less noticeable effect.

The many changes through which the region has passed are shown in a striking manner by the water-courses. The natural trend of drainage is to develop a large stream through the lowest part of the area drained, with tributary streams almost straight and making acute angles with the main stream above their mouths and obtuse angles with it below their mouths. There is no such condition as this to be found in Preston county. The tributaries of Cheat river, the principal stream, are extremely irregular in their development. On the west of the river the tributaries are very short, owing to the barrier wall of the Laurel and other ridges through which they have not been able to cut their channels. On the east side, however, there are long tributaries. These streams do not flow northward to correspond with the current of the parent stream, but have a contrary course toward the south, making obtuse angles above instead of below their mouths with Cheat. This condition might lead to a belief that Cheat once flowed toward the south, but such a belief is untenable because the main tributaries of the river, in Randolph and Tucker counties, are regular and convincing.

The only conclusion that can be reached regarding this irregular drainage on the east side of Cheat in Preston county is that the first mountain foldings of the region must have been irregular in their occurrence, making many warped surfaces, with some minor troughs dipping southward along the east side of the place where Cheat river now flows, and giving the tributaries their first impetus in a direction opposite to that which would seem to be their natural course. The same warped surfaces evidently were the causes which made Muddy and Roaring creeks undergo noticeable changes of direction along their upper courses.

The following table of stream data illustrates the irregular condition of surface with which the water-courses have contended in cutting their present channels:

Table of Stream Data.

STREAMS.	Total Fall, Feet	Total Dist'ce Miles	Rate of fall per Mile	Air line Dist'ce Miles	Ratio T. D. to A. L. D.
Cheat river, Monongalia- Preston line to Sandy creek	36	3.2	11.3	3.0	1.1
Cheat river, Sandy creek to Muddy creek.....	270	9.3	29.0	7.9	1.2
Cheat river, Muddy creek to Rowlesburg.....	189	14.9	12.7	11.2	1.2
Creast river, Rowlesburg to Tucker county line.....	88	11.9	7.4	5.4	2.2
Bull run, mouth to Lick run	522	2.6	200.7	2.4	1.1
Green run, mouth to south fork	358	2.7	132.5	1.8	1.5
Morgan run, mouth to Snyder	450	1.9	236.8	1.7	1.1
Pringle run, mouth to W. Va. Northern Railroad....	476	3.2	148.8	2.9	1.1
Buffalo creek, mouth to Little Buffalo creek.....	373	5.2	71.7	4.1	1.3
Buffalo creek, Little Buffalo to 39° 15' parallel.....	195	2.2	88.6	2.1	1.1
Little Buffalo creek, mouth to 39° 15' parallel.....	160	4.5	35.4	3.3	1.4
Big Sandy creek, mouth to Little Sandy creek.....	551	7.2	76.5	4.6	1.6
Big Sandy creek, Little Sandy to Glade run.....	54	5.1	10.6	4.0	1.3
Big Sandy creek, Glade run to Quebec run.....	43	6.8	6.3	4.5	1.5
Little Sandy creek (North- ern), mouth of Gibbon Glade	123	4.0	30.7	2.9	1.4
Little Sandy creek (South- ern), mouth to Beaver creek	158	5.5	28.7	4.1	1.3
Little Sandy creek (South- ern), Beaver creek to Hazelton	257	6.2	41.4	4.4	1.4
Muddy creek, mouth to Martin creek.....	302	3.2	94.4	2.8	1.1
Muddy creek, Martin creek to Chidester road.....	420	5.6	75.0	4.2	1.3
Roaring creek, mouth to Hayden	566	4.3	131.6	3.5	1.2
Daugherty run, mouth to Dority	1050	5.5	190.9	4.4	1.3
Elsey run, mouth to Rag- tavern run.....	1029	3.4	302.7	2.9	1.2
Saltlick creek, mouth to Amblersburg	217	3.7	58.7	3.4	1.1

STREAMS.	Total Fall, Feet	Total Dist'ce Miles	Rate of fall per Mile	Air line Dist'ce Miles	Ratio T. D. to A. L. D.
Saltlick creek, Amblersburg to Bucklick run.....	256	3.8	67.3	3.1	1.2
Spruce run, mouth to Rode- mer	348	3.3	105.4	2.9	1.1
Wolf creek, mouth to 79° 35' meridian	630	5.0	126.0	4.0	1.2
Little Wolf creek, mouth to forks 1 mi. south of Dayton	525	3.3	159.1	2.7	1.2
Snowy creek, mouth to South branch	70	5.3	13.2	4.2	1.3
South branch, mouth to high- way crossing ½ mile southwest of Portland- Union district line.....	125	4.0	31.3	3.8	1.1
Laurel run, mouth to 2500' contour	115	3.0	38.3	2.7	1.1
Rhine creek, Cherry creek to Maple run.....	11	3.8	2.9	3.2	1.2
Rhine creek, Maple run to Aurora	230	3.9	59.0	3.3	1.2
Maple run, mouth to forks at State line.....	22	2.0	11.0	1.5	1.3
Maple run (east branch), mouth to forks ½ mile northeast of Breedlove...	65	5.4	12.0	4.2	1.3
Maple run (west branch), mouth to Eglon.....	190	4.8	39.6	2.1	2.3
Horseshoe run, Thunder- struck run to 2650' B. M.	825	7.5	110.0	6.4	1.2
Deckers creek, Monongalia- Preston line to Caves run	210	6.8	30.9	4.5	1.5
Threeforks creek, Hardman to Irondale.....	98	2.4	40.8	1.9	1.3
Threeforks creek, Irondale to Squires creek.....	100	5.6	17.9	4.2	1.3
Raccoon creek, mouth to Lyon-Kingwood district line	383	7.2	53.2	5.8	1.2
Sandy creek (of Tygart Valley), Taylor-Preston- Barbour corner to Cole- bank	170	6.2	27.4	4.8	1.3
Little Sandy creek (of Ty- gart Valley), mouth to Fellowsville	93	9.1	10.2	4.3	2.2

The profile of a naturally developed stream would show a steep descent along its upper course, with a gradually decreasing fall toward its lower course. The figures of the table above show that, in many instances in Preston county, the streams do not follow this rule, but the rate of flow depends on either present or ancient structural conditions of the rocks. The last column of the table, giving the ratio of the total distance of stream flow to the air line distance, illustrates fairly well the usual rule that the greater the rate of fall, the nearer will this ratio approach unity. Many of the streams still preserve their ancient sinuous courses developed when they reached base-level conditions while flowing on one of the former peneplains. They have preserved these crooked channels by gradually cutting the same channels to a lower level as the rocks gradually rose in a subsequent elevation of the mountains.

DRAINAGE BASINS.

The drainage of Preston county, with the exception of a few square miles in the extreme southeastern corner, reaches the Gulf of Mexico via the Ohio and Mississippi rivers. The small portion noted as an exception is a part of the Potomac river system emptying into the Chesapeake Bay. The rivers of the Ohio system, which receive drainage from the small streams of Preston county, are the Monongahela, Cheat, Tygart Valley and Youghiogheny. The three latter flow into the Monongahela before it unites with the Allegheny at Pittsburgh to form the Ohio. The drainage of the county belongs, almost entirely, to the Monongahela river.

The following table, computed with planimeter by R. M. Gawthrop, Field Assistant, mainly from the topographic sheets of the United States Geological Survey, gives the drainage basins of all the streams of consequence in the county. The drainage basin of Cheat river was computed from the State Map issued by the West Virginia Geological Survey, which is a reduction by pantograph from the government topographic maps:

Areas of Drainage Basins.

STREAMS	Square Miles
Cheat river, total in all counties.....	1418.00
Cheat river, total of tributaries emptying in Preston county..	486.74
Bull run.....	11.62
Green run.....	11.68
Morgan run.....	7.95
Pringle run.....	10.02
Buffalo creek.....	22.02
Big Sandy creek, total.....	203.14
Little Sandy creek (Southern).....	53.39
Muddy creek.....	33.50
Roaring creek.....	15.21
Saltlick creek.....	34.74
Wolf creek.....	20.18
Snowy creek (not including Laurel run).....	23.03
Laurel run.....	10.77
Rhine creek (above Cherry creek).....	35.19
Horseshoe run (above Leadmine village).....	32.22
Deckers creek, total above Monongalia line.....	32.92
Threeforks creek, portion above Hardman.....	59.62
Raccoon creek	18.51
Sandy creek (of Tygart Valley), portion above, but not including Little Sandy creek.....	32.35
Little Sandy creek (of Tygart Valley).....	38.58

Cheat River.

Cheat river drains one-seventeenth of the area of the State. From its source at the Randolph-Pocahontas county line, where it has an elevation of 4000 feet above sea level, to its mouth at Point Marion, Pa., where it is only 780 feet, it is a turbulent mountain stream with many dangerous rapids. Through many miles of its course it flows between steep mountain walls that make travel along its banks exceedingly difficult. The water has a peculiar black color and pungent taste derived from the vegetation along its upper tributaries, making it unsuitable for domestic use. Since there is a large amount of forest area within its drainage basin, there is a good flow of water throughout the entire year, making it an especially valuable stream for power development. A large private corporation is now engaged in the construction of a series of

dams. One of these, which is partially completed, is in Monongalia county within a few hundred feet of the Pennsylvania State line. Another, on which construction has not yet begun, is at the Monongalia-Preston county line at Beaverhole. The other dams of the system on Cheat river proper have not been definitely located.

Discharge measurements of Cheat river in Preston county are not available. A gaging station has been kept for a number of years at Ices Ferry, in Monongalia county, five miles northwest of the Preston county line. The records of this station have been published in Water Supply Paper 263 of the U. S. Geological Survey, pages 51-62, and also in the Monongalia-Marion-Taylor county report of the West Virginia Geological Survey, pages 48-63.

Since Cheat river has a crooked channel entirely out of keeping with its rapid descent through Preston county, it is evident that it must have obtained this channel by inheritance from a former base-level condition developed during one of the peneplain epochs of the Appalachian region and preserved through the subsequent years of elevation and erosion.

Big Sandy Creek.

Big Sandy creek is the most important tributary to Cheat river in Preston county. From its source at Summit, Fayette county, Pa., where the elevation is 2418 feet above sea level, to its mouth, at a point three miles southeast of Beaverhole, where the elevation is 907 feet, there is a total fall of 1511 feet. Between Little Sandy creek and Cheat river, Big Sandy creek has a fall of 76.5 feet per mile, with three cataracts that range from 10 to 20 feet in height. Through this part of its course it flows between steep mountain walls, sometimes reaching 1000 feet in height, and making travel along its banks almost impossible. Above the mouth of Little Sandy the creek is entirely different. The rate of fall from Glade run to Little Sandy is only 10.6 feet per mile, and the valley walls lose their precipitous character. The noticeable change of flow is largely due to the fact that, between Laurel run and the Lower Falls of Sandy, the creek flows over the hard rocks of the Pottsville

Conglomerate, through which it has been unable to cut its channel sufficiently fast to equalize its current.

The large drainage basin of Big Sandy creek, containing 203.14 square miles, with a large annual precipitation and a run-off fairly well distributed throughout the year, makes it an excellent stream on which to develop water power. The same company which has begun the construction of power projects along Cheat river has also begun the construction of a great dam across Big Sandy creek just below the mouth of Laurel run, one mile northeast of Rockville. This dam will be about 100 feet in height.

The Hydro-Electric Company of West Virginia, which is building the dam noted above, has kept a gaging station at Rockville for several years, but the records of this station, however, are not available.

TOPOGRAPHIC FEATURES.

The physiographic changes, noted earlier in this chapter, make the topography of Preston county extremely complex and varied. The northwestern part, consisting mainly of foot-hills with summits ranging from 1500 to 2300 feet, does not come within the region of the mountain folds and therefore corresponds fairly well with regions farther west that have been described in previous county reports. This part has nearly all been reduced to slope by erosion, the valleys being narrow and the intervening ridges either rounded or sharp. The folding that developed the Chestnut Ridge Anticline at the west edge of the county, shown on Map II, and the gradual rise of the rock system toward the southeast have almost destroyed the evidences of the peneplain that may have existed before the present cycle of erosion began.

The southeastern part of the county, including portions of Portland and Reno, and all of Union district, is distinctly mountainous in character, the variations being much more pronounced than in the western region. A striking feature of this area is that caused by the range of the Laurel Ridge and the Briery Mountains, which together form an almost continuous mountain barrier from the common corner of Preston, Barbour and Tucker counties, at the southeast, to the Maryland State



PLATE IV(a).—Bruceton Mills, showing topography of Allegheny Series in foreground and Conemaugh in background.



PLATE IV(b).—Big Sandy Creek at Bruceton Mills Dam, and topography of Allegheny and Conemaugh Series.

line, near Cranestown, thirty miles to the northeast, broken only by Cheat river and a few smaller streams that have preserved their original channels across it. The summits are composed almost entirely of the hard and sandy rocks of the Pottsville series. West of these mountains the slope is gradual toward the foot-hills. Immediately east of this range the Pottsville rocks are gone and the descent to the valleys, through the softer strata of the Mauch Chunk and Greenbrier series, is abrupt and steep. This peculiar condition gives to the mountains the appearance of an immense dam stretching across the county.

In Union district the mountain forms have less regularity, the folding having been much more intense, and the effect of erosion more pronounced than in the other districts. The mountain ridges are often sharp, with steep descents of a thousand feet or more on either side. There is but little smooth land in this district except in the neighborhood of Aurora and along the south fork of Snowy creek, where the soft rocks of the Mauch Chunk and Greenbrier series have been eroded from above the hard and durable sandstones of the Pocono.

The Cheat river is the most conspicuous topographic feature in the county. For a large part of its length it has cut a deep channel through the mountains and hills that cross its course. This condition is most marked between Albright and Beaverhole, where, for twelve miles, the river flows between canyon walls that rise precipitously from the water's edge on either side to heights that often exceed 1000 feet.

Numerous glades are found throughout the county. As a rule the Preston county glades occur along a stream where the hard rocks of either the Pottsville or Pocono series, dipping in a direction opposite to the course of the stream, have formed a barrier through which it has not been able to cut its channel as fast as through the softer rocks which, under such conditions, are always to be found a short distance up the stream. These soft rocks have been reduced to base-level, leaving wide glades where the drainage is imperfect.

River Terraces.

Terrace deposits of river gravel or rounded boulders were found only along Cheat river. Here five separate deposits were noted as follows:

Mouth of Big Sandy creek,	110' above river by aneroid.
Albright,	35' above river by aneroid.
Madison run,	35' above river by aneroid.
Tucker-Preston line	40' above river by aneroid.
Tucker-Preston line	185' above river by aneroid.

These figures show that three separate terrace formations are represented along Cheat river in Preston county. The deposits at Albright, Madison run and the lower one at the Tucker-Preston line represent the first Ohio river terrace described by I. C. White¹. The deposit at the mouth of Big Sandy creek represents the second Ohio river terrace, while the upper one at the Tucker-Preston line corresponds to the third Ohio river terrace. The deposits at these five places are not conspicuous. The infrequency and scantiness of these deposits along Cheat river indicate that erosion has probably removed nearly all trace of the glacial lake terraces that are so noticeable along the Ohio and Monongahela rivers.

¹Second Geol. Survey of Penna. Report Q, page 10.

PART II.

Geology.

CHAPTER III.

STRUCTURE.

DESCRIPTION OF TERMS.

By **structure** is meant the position of the rocks with reference to a fixed horizontal plane. The structure of a given area that is made up of sedimentary rocks is determined when the position of any one stratum is definitely learned, because the various strata in regions like Preston county, where there are only slight unconformities, are approximately parallel and their height or depth above the plane of reference may be found by addition or subtraction from that given for any one member of the rock column. The study of structure is necessary because the rocks no longer lie in a horizontal position, as originally deposited, but have been wrinkled into folds by the pressure produced in the gradual cooling of the surface of the earth. The place where the rocks have been raised to an arch-like ridge is known as an **anticline**, while the corresponding depression that must exist between any two anticlines is known as a **syncline**. The line which connects all the high points of an anticline or all the low points of a syncline is known as the **axis** of the fold. The place where the axis of a fold bends suddenly upward or downward is called a **nose**. An anticline or syncline is **symmetrical** when the pitch of the rocks on both sides of the axis is at the same angle. It is **unsymmetrical** when the angle

of pitch on one side is different from that on the other. The **dip** of a stratum is the direction in which it pitches downward most rapidly. The dip is usually at right angles to the axis of an anticline, but this is not the case near a nose because the line of dip turns toward the axis. The **strike** of the rocks is always at right angles to the dip. The strike of any particular stratum is an imaginary line joining a large number of points where the stratum lies the same distance from the plane of reference. The strike is usually parallel to the axis of an anticline, but it is no longer so in the vicinity of a nose because the strike line turns rapidly toward the axis. A **fault** is a place where the strata have been broken in two and the rocks on one side of the break have either been thrust upward or have settled downward so that the same stratum lies at a different elevation on each side of the break. An **unconformity** is a place where some particular stratum does not exist because it either was never formed or was removed by erosion before the more recent sediments were deposited above it.

METHODS OF REPRESENTING STRUCTURE.

Structure Contours.—When the dip of the rocks in the area to be studied is gentle, the best way to represent their structure is by means of structure contours drawn on the map so as to show the position of a particular stratum with reference to sea level or some other plane of reference. The key rock lies at the same elevation at all points along any structure contour line, and each contour so determined is a line of strike.

This method of representing structure has been followed in the western part of Preston county. The **Upper Freeport coal** has been used as the key rock because it is an important economic horizon, and also is usually easy to recognize. Its position was determined by spirit level when possible or by aneroid when no other method was available. In places where it lies underground or else has been elevated on the axis of an anticline and later removed by erosion, its approximate elevation was determined by intervals from other known strata either above or below it. If these intervals were constant, the result would be as accurate as a determination of the coal itself, but there is a considerable variation in these both above and

below the coal in different parts of the county, so that the structure contours are only approximately accurate where the coal could not be used. Since the top of the coal coincides with the top of the Allegheny series of rocks, it has been most convenient to base the structure contours on the **top** rather than the **bottom** of the coal. In the preparation of the structure map the following table of intervals, of formations lying both above and below the Upper Freeport coal, was used as a guide, but it may be regarded as only an average of these intervals in the western part of the county where a structure map was made. There are numerous places where local variations of interval are to be found in the lower Conemaugh, Allegheny and Pottsville series. These variations are entirely local in their occurrence and do not depend on any gradual change in the thicknesses of the series that may be formulated into a rule for the guidance of the stratigrapher. Numerous geological sections will be published in Chapter IV that will show these variations in different localities. In the use of the structure map due regard should be given to these sections in computing intervals both above and below the Upper Freeport coal. The thickness of the Mauch Chunk, Greenbrier and Catskill series increases gradually from northwest to southeast, while that of the Pocono remains almost constant throughout the county.

Table of Intervals from Upper Freeport Coal.

FORMATION	Distance of Base above Upper Free- port Coal. Feet.	FORMATION	Distance of Base below Upper Free- port Coal. Feet.
Pittsburgh coal.....	630	Upper Freeport limestone....	15
Little Pittsburgh coal.....	590	Upper Freeport sandstone...	50
Connellsville sandstone.....	505	Lower Freeport coal.....	60
Clarksburg coal.....	500	Lower Freeport limestone..	75
Clarksburg limestone.....	490	Lower Freeport sandstone	
Morgantown sandstone	375	(Upper division).....	120
Elk Lick coal.....	370	Upper Kittanning coal.....	125
Elk Lick limestone.....	360	Johnstown Cement limestone	135
Grafton sandstone.....	325	Hardman fire clay.....	145
Upper Ames limestone.....	320	Middle Kittanning coal....	160
Harlem coal.....	300	Lower Freeport sandstone	
Pittsburgh Reds.....	260	(Lower division).....	170
Saltsburg sandstone.....	210	Lower Kittanning coal.....	180
Bakerstown coal.....	180-200	Clarion sandstone.....	220
Pine Creek limestone.....	180	Clarion coal.....	230
Buffalo sandstone.....	110	Brookville coal.....	250
Brush Creek limestone.....	90	Homewood sandstone (top).	260
Brush Creek coal.....	90	Tionesta coal.....	310
Mahoning sandstone.....	10	Mt. Savage fire clay.....	325
Upper Freeport coal.....	0	Upper Mercer coal.....	330
		Upper Connoquenessing	
		sandstone (top)	400
		Quakertown coal.....	460
		Lower Connoquenessing	
		sandstone (top).....	470
		Sharon coal	520
		Sharon Conglomerate.....	560
		Mauch Chunk Series.....	910
		Greenbrier limestone.....	1060
		Pocono Series.....	1550
		Catskill Series.....	2150

On Map II, which accompanies this report in a separate atlas, the anticlines, synclines and structure contours are shown in green. Structure contours are shown only in the western part of the county and along a small portion of the Mount Carmel syncline in the eastern edge of the county, near Corinth, where the rocks of the Allegheny series are again to be found. A contour interval of 25 feet was used wherever the dips of the rocks are gentle enough for such detail to be shown. In many places, however, the dips are so abrupt that contours of 100-foot intervals only could be used. Care should be taken in the use of the map to notice the contour numbers in green that appear in many places on the contours, showing in each

case the elevation of the coal above sea level that the contour represents. The 100-foot contours are printed with much heavier lines than the intervening 25-foot contours, so that only a little care will be necessary to understand the map. A comparison of the green structure contour at any point with the brown topographic contour at the same point will readily show whether the Upper Freeport coal lies above or below drainage. The position of any other formation may be computed easily, by means of its interval from the Upper Freeport, as given in the preceding table and checked for local variation by reference to the sections in Chapter IV.

The structure map is believed to be accurate within one contour interval, or in other words, within 25 feet where 25-foot contours have been used or within 100 feet where 100-foot contours have been used. Errors of such maps are due to inaccurate levels, mistaken correlations or incorrect intervals assumed from the key rock to other strata. In this report many actual spirit levels have been obtained and in many cases it was possible to use the hand level to carry elevations from points near the outcropping strata. When no other method was available the aneroid was used, being checked on U. S. Government elevations frequently during the day. The strata used were mostly the several members of the Conemaugh and Allegheny series which are usually readily distinguished by a competent observer. The use of intervals presented the most difficulty, but, as previously stated, local determinations, rather than the average interval, were largely utilized.

Cross Sections.—The contour method of representing structure was not found to be available in the southeastern part of the county. In this region the rocks are almost entirely those of the Mississippian or Devonian formations. Since the detailed subdivision of the several series that compose these rocks has never proved practicable, and since these rocks are often tilted at abrupt angles locally in this region, an accurate contour representation of them could not be made. In order to give a fair idea of the structure of this region five cross sections, showing the strata as they would appear if a cutting were made from the surface down to sea level, were prepared.

DETAILED STRUCTURE.

As stated previously, Preston county is situated partly in the foot-hills and partly in the Alleghany mountain region proper and is therefore in a territory that has been much folded and distorted by earth movement. The folds are roughly parallel to the mountain ranges which lie in a northeast-southwest direction. Those which are of sufficient importance to receive names are as follows:

Anticlines.	Synclines.
Chestnut Ridge.	Ligonier.
Hiram.	Evansville.
Preston.	Kingwood.
Briery Mountain.	Glade Farms.
Deer Park.	Mount Carmel.

In addition to the folds above named, which make pronounced structural features in the county, there are a number of minor anticlines and synclines, both at the north and south edges of the county, which are evidently only the ends of structural folds that may reach a much more conspicuous development in contiguous territory not studied or may die away completely a short distance from the county line. For these reasons it was thought best not to give them names, but they are left for geologists of neighboring counties to classify with more significant titles than could be given them in this report.

The anticlines and synclines listed above, as well as the minor folds are all shown on Map II with green dotted lines. Their detailed description is given in the following pages.

Chestnut Ridge Anticline.—The Chestnut Ridge anticline, which is one of the longest and most persistent arches in the State, was named by J. J. Stevenson from the line of hills which it follows through Monongalia county. It has been called the **Laurel Hill anticline** by Rogers¹ and the **Dulaney** by Campbell². It crosses the Pennsylvania-West Virginia line about one mile east of the common corner to Preston, Monongalia and Fayette counties and extends through Preston county five and one-half miles when it crosses the Monongalia

¹W. B. Rogers, *Geology of the Virginias*, p. 369, 1884.

²M. R. Campbell, *Masontown-Unifontown Folio No. 82*, U. S. G. Survey, 1892.

line two and one-fourth miles north of Beaverhole. From this point it continues in a southwest direction across Monongalia, Marion, Taylor, Harrison, Lewis, Gilmer and Calhoun counties.

In Preston county the Upper Freeport coal, if it had not been removed by erosion along the arch, would lie at an elevation of 3000 feet at the Pennsylvania line, but would be only slightly over 2500 feet where the anticline crosses into Monongalia, the dip in the axis being about 90 feet to the mile. This anticline has elevated the rocks to such an extent that none of the coals of the Allegheny series are present along the axis in the county, the only coals found being the thin and irregular ones of the Pottsville series. This feature makes stratigraphic work along the Chestnut Ridge difficult and uncertain.

Hiram Anticline.—A small anticline, first named and described as the **Hiram** by Hennen³, touches southwestern Preston in Lyon district. It lies between the Ligonier and Evansville synclines, extends toward the southwest into Taylor county and is merely the nose of an anticline that possibly has a much more pronounced development in Barbour county farther to the southwest. At the point where the anticline leaves Preston county the Upper Freeport coal has an elevation of 1175 feet. The fold is symmetrical about its axis and has no unusual features.

Preston Anticline.—The Preston, first named and described by Rogers⁴ as the **Preston Axis**, is the next anticline of importance east of the Chestnut Ridge. Prof. Rogers mentions both a "Kingwood Axis" and a Preston Axis as lying between the Kingwood syncline and Chestnut Ridge anticline. Since Map II shows conclusively that there is only one anticline in this territory, and since this anticline corresponds most closely to his description of the "Preston Axis", it will be called the **Preston Anticline** in this report. The axis of this arch crosses the Pennsylvania line into Preston county at a point about two miles northwest of Clifton Mills and extends, in a direction slightly west of south, to Tunnelton, where it

³Ray V. Hennen, Monongalia-Marion-Taylor Report, W. Va. G. Survey; p. 84; 1913.

⁴W. B. Rogers, Fifth Annual Report of Virginia Geological Survey; 1839.

merges into a more abrupt mountain fold that occurs to the southeast. In the northern part of the county the Preston anticline is flat and inconspicuous for the first six miles of its length. It crosses the Brandonville and Fishing Creek turnpike at Hopewell church where it is scarcely perceptible. It crosses Big Sandy creek one-half mile northeast of the mouth of Little Sandy creek and in the neck between these two streams develops a nose that soon makes it a prominent structural feature to the south. The elevation of the Upper Freeport coal is nearly the same at the Pennsylvania line as it is at Big Sandy creek, being about 1700 feet, but from Big Sandy to Cheat river there is a rise of 500 feet along the axis, the elevation of the coal at Cheat being about 2200 feet.

The anticline crosses Cheat one-half mile east of Hackelbarney run and from this point its axis continues to rise to the Morgantown and Kingwood railroad, which it crosses one-half mile east of Manown station. At Oakgrove church, one mile south of the railroad, the Upper Freeport coal has an elevation of 2300 feet above sea level, being higher here than at any other point observed along the anticline. From Manown the anticline continues southward, with a rapidly descending axis, to Tunnelton on the main line of the Baltimore and Ohio railroad, where it flattens out against the fold previously mentioned. At Tunnelton the Upper Freeport coal is only 1875 feet above sea level, the dip from Manown being 425 feet, or 57 feet to the mile.

The Preston anticline is fairly symmetrical about its axis along its entire length, the dip being about the same on both sides. Its most pronounced feature is the great structural dome which occurs at Manown, making the strike angles both north and south of Manown much different from the course of the axis.

Briery Mountain Anticline.—The Briery Mountain anticline, first named and described by Rogers³ as the **Briery Mountain Axis**, is one of the most important folds of Preston county. It is due to the upheaval of this great anticline, probably in Permian time, that the coal measures, and in many

³W. B. Rogers, Fifth Annual Report of Virginia Geological Survey; 1839.

places even the oil sands of western West Virginia, have been elevated to a great height and later washed away from a large part of eastern Preston county. If the rocks of this region had remained level, as originally deposited, the ultimate value of the hydro-carbons of this region could safely be figured as many millions of dollars, since it is safe to say that the region once contained at least 4,000,000,000 tons of coal. The presence of several coal seams, identical in appearance and structure, both east and west of this region of folding is sufficient proof that they once were continuous across the entire surface of what is now Preston county.

This is the same anticline as that described by Stevenson⁶ as the **Laurel Ridge**. Concerning this anticline Dr. Stevenson makes the following statement:

"Laurel Ridge axis enters West Virginia at the northeast corner of Preston county, or very near the angle formed by Pennsylvania, Maryland and West Virginia. It is not the Briery axis of Prof. W. B. Rogers, but is the same with that which he named the Kingwood axis."

For reasons already stated under the description of the Preston anticline, the name of Kingwood anticline, or Kingwood axis, has not been applied to any structural fold in this report. By reference to the structure contours on Map II, it will readily be seen that the Laurel Ridge anticline is undoubtedly a northern extension of the Briery Mountain axis of Rogers. Since Prof. Rogers' description of the anticline was published many years before that of Prof. Stevenson, his classification of it as the Briery Mountain anticline will be recognized in this report.

The anticline enters the State from Maryland about one-half mile south of the common corner to West Virginia, Maryland and Pennsylvania. Its course through the county is almost due south for the first twelve miles. Starting three miles from the Pennsylvania line there is a pronounced nose, the Upper Freeport coal rising rapidly along the axis as far south as contours are shown.

At Cranestown, near the Maryland State line, the Briery Mountain anticline is a barely perceptible structural feature,

⁶J. J. Stevenson, Report KKK, Second Geol. Survey of Pa., p. 268; 1877.

as may be seen by referring to the Cranesville, AA' cross section. From Cranesville it extends southwestward and crosses the Baltimore and Ohio railroad at the west end of the corporation line of the town of Terra Alta where the arch in the rocks is plainly visible even from a fast moving train. At this point the olive green rocks of the Chemung series are at the surface, the base of the Catskill series belonging only a short distance above.

From Terra Alta the anticline extends south 20° to 25° west through Portland and Union districts, crossing Lantz ridge 1½ miles west of Amboy and reaching the Northwestern Turnpike about one mile northeast of Hardesty. At this point the arch is hardly perceptible and its course could not be traced further south as it evidently dies out or merges into the next anticline to the southeast.

The anticline reaches its greatest development at Terra Alta and in the region immediately south. The Terra Alta cross section, BB', shown on the margin of Map II, shows that it is symmetrical about its axis, the dip being about the same on both sides. The Amblersburg, CC', and Rowlesburg, DD', cross sections show that it is unsymmetrical, the dip at both cross sections being much greater east of the axis than it is to the west. It is quite evident that the crest of this anticline was once the crest of the Briery Mountain range from which it takes its name, although subsequent erosion of the rocks from its summit has gradually moved the crest of the range westward until it is now from two to three miles removed from its original position.

Deer Park Anticline.—The Deer Park anticline of Martin⁷ affects the geology of Preston county but little, since it extends through only a small corner of Union district. In Maryland it crosses Garrett county in a northeast-southwest direction, its axis passing about two miles northwest of Deer Park and directly through Mountain Lake Park, after which it could have been more appropriately named. It crosses the Maryland-West Virginia state line one-half mile south of Monument No. 7. From this point its course is southwest, the axis being

⁷G. C. Martin, Accident-Grantsville Folio No. 160, U. S. G. Survey; 1908.

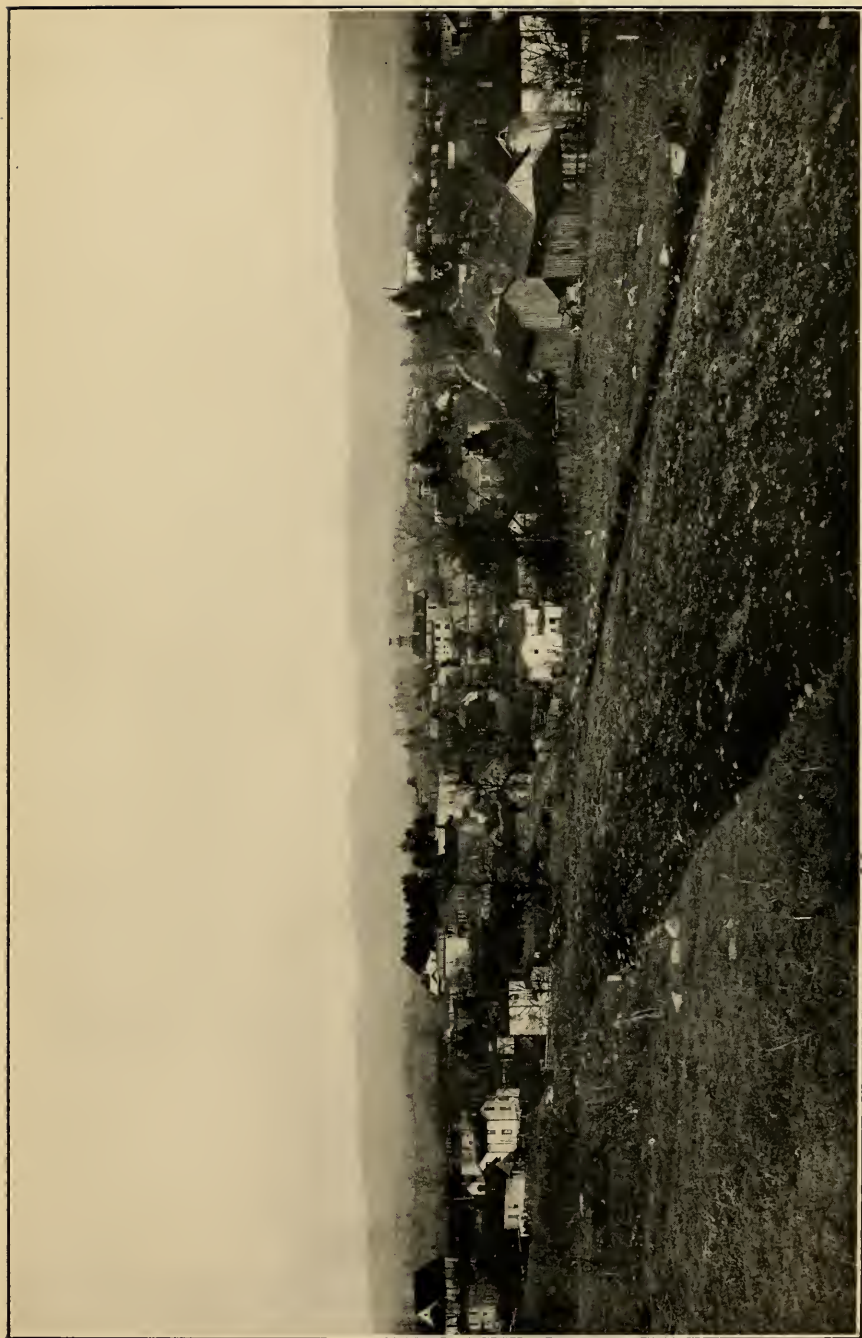


PLATE V.—View of Kingwood looking east. Briery Mountain formed by Pottsville in background.

Photo by E. E. Knight

nearly a straight line, and passes into Tucker county at Horseshoe run. The anticline is shown in the Rowlesburg, DD', and Preston-Tucker, EE', cross sections on the margin of Map II. Owing to the fact that much of this region is in the Chemung series, which has no definite subdivisions, the dip as shown on the cross sections should be regarded as only approximate.

Minor Anticlines.—In addition to these anticlines just described there are several short folds at the north and south ends of the county that, for reasons previously mentioned, have not been named on the map. There is a short one at **Five Forks**, four miles west of the common corner to West Virginia, Maryland and Pennsylvania that extends southwest into Preston county scarcely four miles. Inasmuch as the structure contours on the Masontown-Uniontown Folio No. 82 of the U. S. G. Survey, immediately to the north do not show a corresponding anticline, the conclusion is apparent that this anticline does not extend far into Pennsylvania.

At the south end of the county a small anticline passes through the village of Marquess in Reno district. It crosses into Barbour county one mile south of Marquess. It is short and has such slight relief from the general slope that it is of little importance.

At Rowlesburg, the western slope of the Briery Mountain anticline is broken by a shallow syncline west of which there is an important fold that develops rapidly toward the southwest until it reaches the Tucker county line. At Rowlesburg the axis is scarcely perceptible in the public highway south of the Baltimore and Ohio railroad. Two miles southwestward, where the anticline crosses Cheat river and the Macomber road, it is more pronounced, and, along the Northwestern turnpike, on Flag run, it is plainly visible. At **Etam**, directly through which the anticline passes, the rocks dip at a sharp angle on both sides. The sharp nature of the fold continues southward to the Tucker county line, which it crosses 2.2 miles due west of Hannahsville. The olive green rocks of the Chemung series are exposed above drainage all along its course, but the base of this series could not be found. It is reasonable to believe that this anticline will have an extensive development in Tucker county where it can be given a more appropriate name

than that of **Etam anticline** by which it will be referred to in future pages of this report.

At the village of **Eglon**, in the southeastern part of Union district, a minor fold interrupts the smooth western slope of the Deer Park anticline. Its axis extends southwestward, $5\frac{1}{2}$ miles to the Tucker county line, which it crosses near the head of Twelvemile run. The rocks exposed along it are of the Catskill and Chemung series.

Ligonier Syncline.—The Ligonier syncline is the most western structural basin in Preston county. It was named by geologists of the Pennsylvania Survey from the Ligonier Valley in that State and its course was traced southwestward to the West Virginia line. It enters Preston county, 3.8 miles northwest of Clifton Mills and from this point its course is almost straight, about south 30° west to Newburg on the Baltimore and Ohio railroad. It crosses Laurel run one-half mile east of Laurel church, crosses Big Sandy creek twice along the bend west of Rockville, crosses Cheat river one-fourth mile northwest of the mouth of Big Sandy and passes one-half mile east of Browns Mills. At Newburg the syncline divides, the main branch turning sharply to the southwest. It crosses the Preston-Taylor line one mile south of Hardman. From this point it passes through Taylor county by way of Grafton, Pruntytown and Flemington to the Taylor-Barbour county line.

The geology of the Ligonier syncline is essentially that of the coal measures. Except for about two miles along the deep gorges of Big Sandy creek and Cheat river, where the Pottsville and Mauch Chunk rocks are exposed, and at Newburg where the basal members of the Monongahela series appear, the surface rocks along the entire length of the syncline are those of the Conemaugh and Allegheny series. Since the coals of these two series have an exceptionally good development in this region, the basin will probably in time become one of the most important mining districts in the State. Mining operations already begun and successfully conducted along the basin bear witness to this assertion.

In the northern part of the county the syncline is not symmetrical about its axis. On the west the rocks rise rapidly toward the great Chestnut Ridge anticline, while on the east

the rise is much more gentle to the low summit of the Preston anticline. At the State line the Upper Freeport coal has an elevation of 1670 feet above sea level, and the variations from this elevation are but slight as far south as Cheat river. South of Cheat the syncline becomes more symmetrical about its axis, since the Preston anticline to the east has a much more conspicuous development, thus making the rise on both sides of the Ligonier syncline much more uniform. Between Cheat river and Reedsville there are two depressions along the axis that carry the coal down to the 1525-foot level. One mile south of Reedsville the axis of the syncline sinks rapidly to the low structural basin at Newburg, where the coal has an elevation of only 1075 feet. Westward to the Taylor county line there is not much change in elevation, the coal having a height of slightly more than 1100 feet at this point.

The Ligonier syncline does not visibly affect the topography of the region through which it passes. There is no valley following along any considerable portion of its length, and the drainage streams cut across it indiscriminately in all directions. The general difference of surface elevations between the axis of the Chestnut Ridge anticline and the axis of the Ligonier syncline is due to an abnormal elevation of the rocks by the anticline rather than to a corresponding depression by the syncline.

Evansville Syncline.—At Newburg, on the main line of the Baltimore and Ohio railroad, the Ligonier syncline divides into two branches. The main axis, as previously described, turns westward toward Taylor county. The other branch, which has been named and described by Hennen⁸ as the **Evansville syncline**, continues nearly south, by way of Evansville, 6½ miles to Dent, on the Barbour county line. Just south of Newburg the Upper Freeport coal is depressed to the 1050-foot level above sea, this being its lowest elevation in Preston county. The Evansville syncline has no unusual features. It is fairly symmetrical about its axis. South from the low basin just mentioned the coal along the axis rises until, at the Barbour county line, it has an elevation of 1200 feet above the sea. The

⁸Ray V. Hennen, Monongalia-Marion-Taylor Report, W. Va. G. S., p. 89; 1913.

surface rocks along it are those of the Lower Monongahela and Conemaugh series.

Kingwood Syncline.—The next basin that is continuous across a considerable part of the county, east of the Ligonier, is the **Kingwood syncline**. This structural depression was named by Rogers⁹ the **Kingwood Basin**, a title that will be honored in this report. This syncline crosses the Pennsylvania state line 1.8 miles N. 23° W. of Clifton Mills. It is not probable that it extends far into Pennsylvania, as the Mason-town-Uniontown Folio No. 82 of the U. S. Geological Survey, which reaches within two miles of the West Virginia line, does not show a corresponding syncline. From the point on the State line just named, the syncline extends nearly due south, along the valley of Big Sandy creek to Bruceton Mills. A short distance south of Bruceton Mills it veers to a course about S. 22° E. and continues in this general direction for five miles, nearly to Guseman. Three-fourths mile north of Guseman it turns to a course S. 25° W., which is almost straight to the southern terminus of the syncline. It passes one-fourth mile west of Guseman, lies just east of Muddy creek, and crosses Cheat river at Albright. It crosses the Terra Alta turnpike, 1½ miles east of Kingwood, crosses to the east side of Cheat river at Dunkard Bottom, crosses again to the west side one-half mile south of Trowbridge Ferry, and reaches the Baltimore and Ohio railroad at Anderson, 1½ miles east of Tunnelton, where it dies out completely against the western slope of the Etam anticline.

In northern Preston county the Kingwood and Ligonier synclines, together with the low-lying Preston anticline that separates them, make a structural depression between the much higher structural levels both to the east and to the west, that is a marked feature. At the State line the Upper Freeport coal has a tidal elevation of 1700 feet, and at Bruceton Mills it is only 1625 feet. South of Bruceton Mills the coal rises rapidly along the axis to a point one mile northeast of Valleypoint, where it reaches a tidal elevation of nearly 1900 feet in a high structural saddle that almost cuts the syncline into two sepa-

⁹W. B. Rogers, Fifth Annual Report of Virginia Geological Survey; 1839.

rate basins. From this point southward to Albright the coal dips continuously along the axis, at the rate of 125 feet to the mile, until it reaches the low level of 1100 feet above sea. From Albright southwestward to Anderson the coal rises rapidly, at the rate of 85 feet to the mile, until it reaches a tidal elevation of 1800 feet at the latter point. From Guseman south to its terminus at Anderson the syncline is unsymmetrical about its axis, the rise of the rocks toward the Briery Mountain anticline on the east being much more rapid than toward the Preston anticline on the west.

Topographically the Kingwood syncline is influential. Along its northern end the valley of Big Sandy creek follows its axis closely for five miles. At Guseman, Muddy creek forsakes its previous western course and turns abruptly to the south along the rapidly dipping axis of the syncline, which it follows to its mouth near Albright, a distance of nearly six miles. South of Albright Cheat river, flowing northward, follows the axis of the syncline closely for eight miles. This leaves only about five miles of the syncline, directly under the high saddle between Bruceton Mills and Guseman, that does not have important drainage flowing along it. In view of the great change of direction that takes place in Muddy creek at Guseman, it seems entirely probable that the water of this stream once continued northward into the Big Sandy valley, but was suddenly changed to a southern course by the rapid development of the structural basin at Albright, probably in Permian time.

The surface geology of the Kingwood syncline is principally that of the Conemaugh and Allegheny series. The base of the Monongahela series, containing the Pittsburgh coal, is preserved in the low structural basin south of Albright. The presence of these areas containing valuable coal seams, insures that this syncline, like the Ligonier basin, will be a scene of great mining activity, as is already evidenced by developments in the vicinity of Kingwood.

Glade Farms Syncline.—This is a short local basin extending closely along Hog run from Little Sandy creek northeastward to the Pennsylvania line, 1 mile northward from Glade Farms. This syncline and the **Five Forks anticline**, slightly over a mile westward, were not recognized by Campbell of the

U. S. Geological Survey on the structure contour map of the Uniontown Quadrangle, 2 miles northward.

Mount Carmel Syncline.—East of the Briery Mountain anticline the rocks of the county are again depressed into another important syncline. This structural trough was first described and named by Rogers¹⁰ as the **Mount Carmel Basin**. It was later described and named by Martin¹¹ as the **Upper Youghiogheny syncline**. Since the report of Prof. Rogers was issued many years previous to the publication of the Accident-Grantsville folio his classification should be recognized and the basin will therefore be known in this report as the **Mount Carmel syncline**.

The syncline, as shown on Map II, enters the county at Hutton, Md. Its course in Maryland, according to the Piedmont folio of the U. S. Geological Survey, is northeastward for about six miles. It then turns sharply northward, according to the Accident-Grantsville folio, and follows closely the valley of the Youghiogheny river to the Maryland-Pennsylvania state line. Its course in West Virginia, for the first two miles of its length, is nearly due south until it crosses Laurel run, where it again touches the Maryland state line. At Laurel run it turns westward and continues with a course about S. 50° W. to its southern terminus. It passes almost midway between Amboy and Carmel, passes about one mile northwest of Aurora; crosses the Northwestern turnpike one-half mile northeast of Dayton, where it is scarcely perceptible, and dies out completely in the gorge of Little Wolf creek, two miles to the southwest.

The West Virginia end of the syncline influences the topography but little. Between Hutton and the Brushy Knobs it follows the general direction of Snowy creek and its tributary, Laurel run, but to the southwest there is no drainage or surface relief that shows its course. As shown by the structure contours along the State line, and the Amblersburg, CC', and Rowlesburg, DD', cross sections, published on Map II, it is fairly symmetrical about its axis, the rise being much alike on either side.

¹⁰W. B. Rogers Fifth Annual Report of Virginia Geol. Survey; 1839

¹¹G. C. Martin, Accident-Grantsville Folio No. 160, U. S. G. Survey; 1908.

The surface geology of the syncline in the county varies from the Upper Carboniferous at the north end to Devonian at the south end. At the Maryland state line, where the syncline crosses the Baltimore & Ohio railroad, the Upper Freeport coal horizon has a tidal elevation of 2400 feet, showing that the base of the Conemaugh series covers the surface. Southward along the axis the rise of the rocks is fairly uniform at the rate of 100 feet to the mile for the first three miles. This rise soon brings the Lower Kittanning coal to the surface. This coal is well developed in this region and has been mined at several points. The dip of the measures toward the valley of Snowy creek from both sides of the axis makes a favorable condition for economical mining operations. Southwestward from Laurel run the rise of the rocks is very rapid, the base of the Allegheny, Pottsville, Mauch Chunk and Greenbrier series appearing successively within a distance of less than four miles. At the falls of Wolf creek, west of Carmel, the Pocono sandstone appears. At the southern end of the syncline, along Little Wolf creek, the surface rocks are those of the Chemung series.

Minor Synclines.—Several short synclines appear at the north and south ends of the county. In the northeast corner there is a shallow syncline that crosses the Pennsylvania line, 2.3 miles west of the common corner to West Virginia, Maryland and Pennsylvania. It extends a little west of south for five miles and disappears at Little Sandy creek in the general eastward rise of the rocks toward the Laurel Ridge and Briery Mountain anticlines.

In the southern end of the county, in Reno district, a short syncline appears west of the Etam anticline. Only four miles of it is in Preston county. It crosses Sandy creek, 1.3 miles northwest of **Colebank**, where its axis is rising. It is possible that this syncline is more highly developed in Barbour county, and for that reason it is not named in Preston.

Along the valley of Cheat river, south of Rowlesburg, a syncline appears that assumes important proportions only after it has crossed the line into Tucker county. At its north end it may first be noticed along the Baltimore and Ohio railroad, one mile east of Rowlesburg, where its development is slight. From this point it extends southeastward, as shown on Map II., for about five miles to Erwin, where it crosses Wolf creek and

where it is still inconspicuous. From Erwin its course was followed southwestward nearly to **Hannahsville**, in Tucker county, south of which no investigation was made. It crosses Cheat river twice between Erwin and the county line, but the structural depression along the axis is slight. It crosses the county line along Limestone mountain. South of the county line the syncline is much more pronounced and easily recognized. The surface geology is that of the Mississippian and Devonian rocks. South of the county line there is an extensive outcrop of the Greenbrier limestone.

In southeastern Preston there is a minor syncline just west of the Deer Park anticline. It extends from Horseshoe run southwestward four miles to the Tucker county line, south of which its course is unknown. As shown by the Rowlesburg, DD', and Tucker-Preston, EE', cross sections on Map II, its surface geology is that of the Catskill and Chemung series of the Devonian.

Cranesville, AA', Cross Section.—At Cranenville near the eastern edge of the county a cross section was made, about five miles long, approximately at right angles to the line of strike, and with a vertical and horizontal scale of 1-62500, which is the same as the topographic maps. The line of the cross section, with its index letters, is shown in place on Map II and the cross section itself is printed on the margin.

Terra Alta, BB', Cross Section.—At Terra Alta another cross section, about 8 miles long, was made in the same manner. Since this section shows the Chemung rocks, the thickness of which is only conjectural, at the surface, along Briery Mountain anticline, the lower portion of the section was left blank. The bottom of the Chemung was not found at any point in the county and as no drilling records are available to show its thickness an arbitrary thickness of 1200 feet was assumed, based on measurements made by I. C. White¹² at Piedmont, many miles distant.

Amblesburg, CC', Cross Section.—Near Amblesburg, as shown by the alignment and index letters on Map II, another cross section was made, about twelve miles long. Like the Terra Alta cross section, much of the lower portion of it was

¹²Notes on the Geology of W. Va., Proc. Am. Philosoph. Soc., pp. 438-446; 1881.

left blank owing to lack of information. The impossibility of making definite subdivisions of the Catskill and Chemung series makes the accuracy of any cross section doubtful where these are the only surface rocks available for stratigraphic work.

Rowlesburg, DD', Cross Section.—Another cross section, $14\frac{1}{2}$ miles long, was made passing through the mouth of Saltlick creek at Rowlesburg and touching the Maryland state line where it crosses Backbone Mountain. This section is almost entirely in the region of the Catskill and Chemung outcrops, and the actual elevations are therefore open to question at some points, but the points of crossing of the anticlines and synclines are believed to be horizontally correct.

Preston-Tucker, EE', Cross Section.—A cross section, 17.8 miles long, was made coincident with the line between Preston and Tucker counties except at the southeast end where the county line turns southward at the Potomac stone. This section shows only the general slope of the rocks. The rocks of the southeastern corner of the county, through which this section passes, are much disturbed by violent local folds which could not be shown on the cross section. Dips of 70 degrees were shown by the clinometer at some points along Horseshoe run, and there is reason to believe that there are local overturns in this region because dips were sometimes found that were contrary to those indicated by the general direction along the same line of strike.

Unconformities and Faults.—No evidence of important unconformity was found. The Pottsville series does not always have its usual number of sandstones, but their absence is often due to a replacement by sandy shales rather than to any extensive disappearance of a portion of the series. There is a considerable variation in the thickness of the series, but since the sandstones that compose it often vary in the same way, the variation in the total thickness of the series can scarcely be attributed to unconformity. The Pottsville series is always unconformable with the underlying Mauch Chunk Red Shales, but there is practically no unconformity in the dips of the two formations, and there is no evidence of very extensive erosion of the Mauch Chunk series.

One-fourth mile west of the corporation line of Terra Alta

there is evidence of a slight fault in the Chemung series, as there is a sudden reversal of dip that can scarcely be accounted for in any other way. The presence of a ravine, at the point where the fault seems to be, makes it impossible to be certain of its nature or extent. Since no evidence of the same feature could be found, either to the north or south along the same line of strike, the disturbance must be regarded as local.

CHAPTER IV.

STRATIGRAPHY—GENERAL SECTIONS.

INTRODUCTION.

The standard classification of sedimentary, or stratified rocks, as adopted generally throughout the world by geologists, and based largely on comparative studies of fossil, plant and animal life contained in the rocks themselves, has been published in previous county reports of this Survey. Since a knowledge of this classification is necessary to intelligent use of the next eight chapters, it is republished as follows:

Quaternary—Largely present life forms.

Cenozoic—Recent life forms.

Mesozoic—Less recent life forms.

Paleozoic—Oldest forms of life.

Archean—Generally crystalline rocks without fossils, nearly all traces of life having been destroyed.

The surface rocks of West Virginia belong principally to the Paleozoic System, which is subdivided further into five ages, as follows:

Carboniferous	{	Upper	{ Permian, or Permo-Carboniferous.
		Lower	{ Coal Measures, or Pennsylvanian.
			{ Subcarboniferous, or Mississippian.
Devonian.	{	Catskill.	
		Chemung.	
		Portage.	
		Hamilton.	
		Corniferous.	
		Oriskany.	
	{	Helderberg.	
Silurian.			
Ordovician.			
Cambrian.			

With the exception of a few unimportant deposits of Quaternary clays, sands and gravels, the rocks of Preston county are all included in the groups from the Pennsylvanian to the Chemung, inclusive. There is abundant evidence that rocks of Permian or Permo-Carboniferous age once covered the county, because they are found both to the west in Monongalia county and to the east in Garrett county, Maryland. They have been eroded so completely that no trace of them now remains in Preston. The Carboniferous and Devonian rocks of Preston county have the following thickness and classification by series:

Upper Carboniferous (1175 to 1400 feet).

Dunkard, or Permo-Carboniferous Series (entirely removed by erosion).

Monongahela Series (about 100 feet of basal portion left in Evansville syncline).

Conemaugh Series (600 to 650 feet).

Allegheny Series (225 to 300 feet).

Pottsville Series (250 to 350 feet).

Lower Carboniferous or Mississippian (950 to 1300 feet).

Mauch Chunk Shales (300 to 600 feet).

Greenbrier Limestone (150 to 200 feet).

Pocono Sandstones (500 feet).

Devonian (1800 to 2100 feet exposed).

Catskill Sandstones and Shales (600 to 900 feet).

Chemung Sandstones and Shales (not all exposed, probably about 1200 feet).

Numerous sections were made throughout the county that will show the succession, thickness and character of the several formations. Some of these were made along steep hill roads where outcrops were abundant and others were made in ravines and along hillsides. These surface measurements have been supplemented by diamond drill holes and oil well records.

GRANT DISTRICT.

The following section was measured by Reger with aneroid in descending order along the steep hill road immediately north of Rockville:

Section North of Rockville, Grant District.

	Thickness Feet.	Total Feet.
Conemaugh Series (50')		
Sandstone, massive, Mahoning.....	50	50
Allegheny Series (260')		
Concealed, mostly sandstone.....	155	205
Coal blossom, thick, concealed, Middle Kittanning, (elevation, 1545' B-A. T.).....	0	205
Concealed	80	285
Fire clay.....	4	289
Coal, Clarion (elevation, 1465' B-A. T.).....	1	290
Fire clay and concealed.....	20	310
Pottsville Series (130')		
Sandstone, massive, Homewood.....	50	360
Concealed to Sandy creek.....	80	440

The following section, the surface portion of which was made with stadia measurement by Dr. F. L. Slocum, geologist for the Hydro-Electric Company of West Virginia, and the lower portion of which is the record of a core test made by the same company, is located along Big Sandy creek at the north end of the axis of a power dam that this company is building. Diggings were made into the hill to get the sections of the surface coals. The Survey is responsible for the details of these coals as well as the identification of the various formations that compose the section:

Section on Big Sandy Creek, 1 Mile Northeast of Rockville, Grant District.

	Thickness Feet.	Total Feet.
Conemaugh Series (100')		
Concealed, sandstone, and concealed from summit (estimated).....	100	100
Allegheny Series (243')		
Coal, slaty.....0' 4" } Upper Freeport.....	2.5	102.5
Slate, black...0 2 } (Elevation of base,		
Coal, soft.....1 2 } 1696' L-A. T.)		
Slate, black...0 1 }		
Coal 0 9 }		
Concealed	26	128.5
Sandstone, massive, Lower Freeport.....	49.5	178.0
Concealed	78	256.0
Slate, brown.....	6	262.0
Coal, Lower Kittanning.....	1	263.0
Concealed	56.5	319.5
Shale, black, with plant fossils.....	12	331.5
Coal, Clarion.....	1.5	333.0
Concealed	10	343.0

	Thickness Feet.	Total Feet.
Pottsville Series (223.3')		
Sandstone, massive, Homewood.....	72.3	415.3
[Hydro-Electric Co. of W. Va. Core Test No. 3 (16)]		
Sandstone, coarse, massive, Homewood.....	8	423.3
Black slate with coal, Tionesta.....	2	425.3
Fire clay, with black slate parting.....8.1' } Mt. Savage..	10.3	435.6
Fire clay, hard, shale, with streaks of sand..2.2' }		
Slate, sandy	1.5	437.1
Coal, Upper Mercer.....	0.8	437.9
Slate, dark	1.1	439.0
Fire clay, hard.....	3.7	442.7
Slate, sandy	14.6	457.3
Fine grained, quartzose sand.....	4.5	461.8
Fine grained, quartzose sand, alternating with shale	6.5	468.3
Sandstone, fine grained.....	3.3	471.6
Shale, hard, sandy.....	0.4	472.0
Sandstone, fine grained.....	2.5	474.5
Sandstone, fine grained, with coal partings (Quakertown)	3.7	478.2
Slate, dark	3.7	481.9
Slate, and shale.....	6.8	488.7
Fire clay shale.....	1.5	490.2
Shale, soft, slightly silicious.....	7.5	497.7
Shale, soft, slightly silicious, harder.....	2.3	500.0
Shale, hard, sandy.....	10.5	510.5
Sandstone, fine grained.....	8.5	519.0
Shale	1.2	520.2
Sandstone, coarse	0.5	520.7
Sandstone, fine grained.....	2.5	523.2
Shale, dark, sandy.....	2.0	525.2
Sandstone, shaly	4.2	529.4
Sandstone, fine grained.....	0.7	530.1
Shale, dark	0.7	530.8
Sandstone, fine grained, with dark shale partings	0.3	531.1
Slate, hard, black.....	5.5	536.9
Slate, soft, black (3 ft. of core lost).....	7.4	544.3
Slate, hard, black.....	1.0	545.3
Shale, gray	10.5	555.8
Sand with shale partings.....	2.0	557.8
Shale, gray	1.0	558.8
Clay, fine	0.2	559.0
Shale, gray	2.0	561.0
Fire clay (4.3 ft. of core lost).....	5.3	566.3
Mauch Chunk Series (40')		
Shale, hard, green.....	10.8	577.1
Shale, broken, green	4.3	581.4
Shale, broken, hard, green.....	5.2	586.6
Shale, broken, green, hard, a little sandy....	3.5	590.1
Shale, hard, green (2.4 ft. of core lost).....	9.0	599.1

	Thickness	Total
	Feet.	Feet.
Shale, red (0.5 ft. of core lost).....	0.8	599.9
Shale, green	2.1	602.0
Shale, red, to bottom.....	4.3	606.3

The following section was made by Hennen along the north side of the gorge of Big Sandy creek, near Rockville. Measurements are by aneroid in descending order:

Section 1.8 Miles Northwest of Rockville, Grant District.

	Thickness	Total
	Feet.	Feet.
Conemaugh Series (15')		
Sandstone, Mahoning	10	10
Fire clay, good.....	5	15
Allegheny Series (230')		
Concealed	125	140
Sandstone, Lower Freeport.....	50	190
Concealed	55	245
Pottsville Series (140')		
Sandstone, white, Homewood.....	15	260
Concealed	35	295
Coal, trace, Tionesta.....	0	295
Fire clay, good, Mt. Savage.....	5	300
Sandstone, massive, Upper Connoquenessing	35	335
Coal, Quakertown (Elevation, 1450' B-A. T.)	1	336
Fire clay, dark, sandy.....	3	339
Concealed to run.....	46	385

The following section was compiled by combining two core tests drilled by the Hydro-Electric Company of West Virginia along the west side of Big Sandy creek, 1.3 miles northwest of Brandonville. The tests were drilled within a few hundred feet of each other at nearly the same structural level along the Kingwood syncline, and accurate spirit levels were run between them by the company. The record of No. 2 is given complete, but only that portion of No. 1 is used that lies below the bottom member of No. 2. Identifications are by the Survey. The latter boring starts nearly flush with the top of the Allegheny series, the Upper Freeport coal apparently belonging in the first 15 feet of the section, here concealed by surface debris:

Brandonville Section, Grant District.
[Hydro-Electric Company of W. Va., Core Test No. 2
(Map No. 6).]

	Thickness		Total		Elevation
	Ft.	In.	Ft.	In.	Bottom Feet.
Allegheny Series (283' 1½").					
Boulders and clay.....	15	0	15	0	1680.9
Sandstone, gray, with heavy brown streaks (Upper Freeport).....	24	0	39	0	1656.9
Shale, dark, turning to fire clay.....	17	6	56	6	1639.4
Fire clay, dark, rotten.....	8	0	64	6	1631.4
Shale, sandy, streaked with sand, turning to black slate.....	0	4	64	10	1631.07
Coal 0' 10 " }	3	7	68	5	1627.49
Slate 0 0½ } (Lower Freeport					
Coal 2 8½ }					
Fire clay, dark shale.....	0	7	69	0	1626.90
Limestone, dark....1' 0" }	7	0	76	0	1619.90
Fire clay, dark gray 1 -2 }					
Limestone, little lighter in color than above.....4 10 }					
Fire clay and shale, lower portion firmer	15	4	91	4	1604.57
Bone coal.....0' 1½" }	1	2	92	6	1603.4
Coal 0 0½ } (Local)					
Fire clay.....1 0 }					
Shale, hard sandy, plant fossils in upper portion, gradually turning to sandstone in bottom.....	5	6	98	0	1597.9
Sandstone, hard, gray, changing in texture coarse near bottom (Upper Member of Lower Freeport..	32	6	130	6	1565.4
Fire clay, (Upper Kittanning-Bruceton coal horizon) streaks of sandstone turning to dark fine grained sandstone	7	0	137	6	1558.4
Sandstone, gray Lower Member of Lower Freeport.....	39	6	177	0	1518.19
Shale, dark, sandy.....	4	6	181	6	1514.40
Shale, dark, fine grained, hard.....	9	0	190	6	1505.40
Slate, black, splits with clean, smooth fracture, (Lower Kittanning coal horizon)	1	0	191	6	1504.40
Slate, hard sandy.....	1	0	192	6	1503.40
Fire clay, sandy..1' 6" }	10	6	203	0	1492.90
Fire clay, hard, light in color..5 6 }					
Fire clay, hard..3 6 }					
Sandstone, dark.....	2	6	205	6	1490.4

(Continued in Hydro-Electric Company of W. Va. Core Test No. 1 Map No. 7).

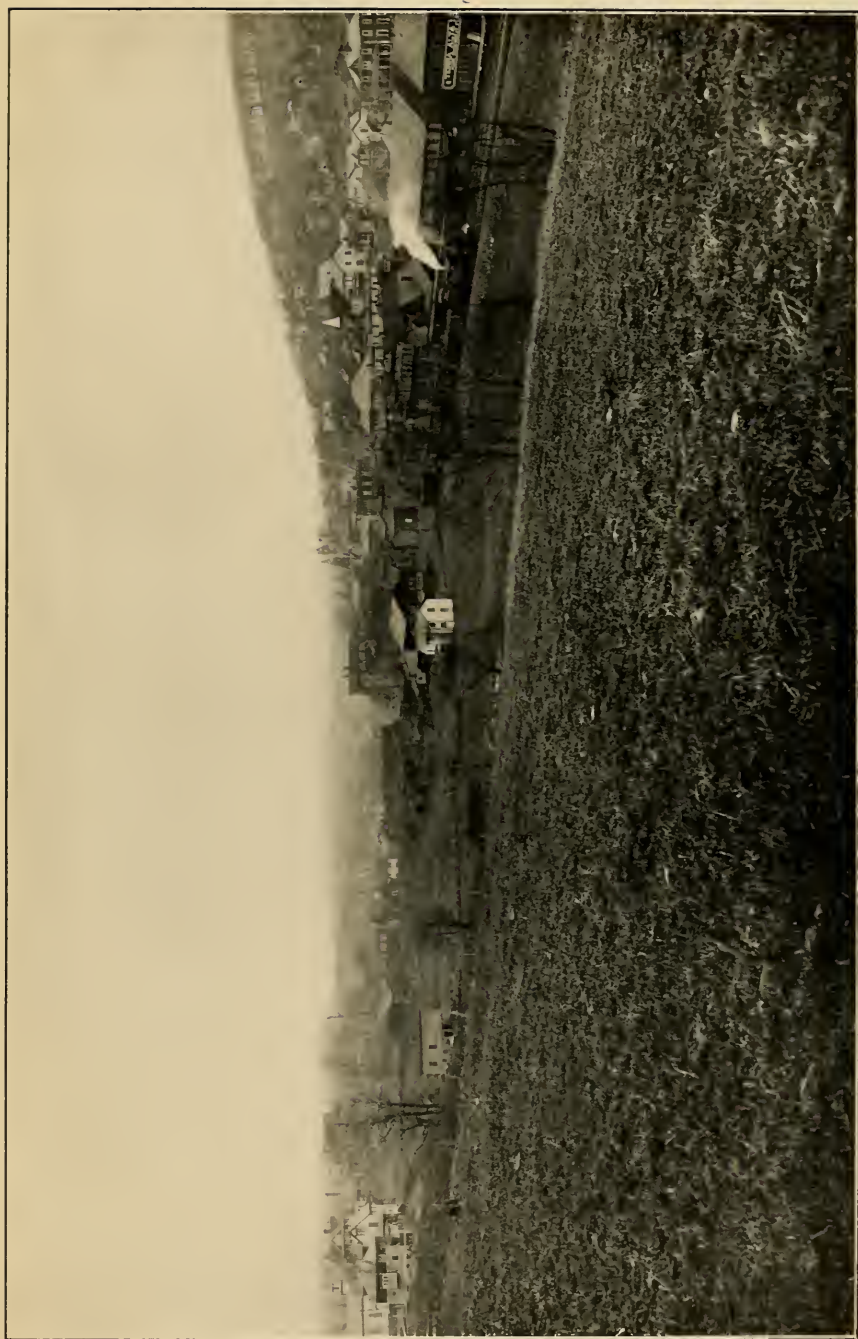


PLATE VI.—View of Terra Alta looking north west. Topography principally in Catskill Series.
Photo by E. E. Knight

	Thickness		Total		Elevation
	Ft.	In.	Ft.	In.	Bottom Feet.
Sandstone, gray, very hard changing to darker color, showing dark streaks near base.....	10	6	216	0	1479.9
Sandstone, gray or brownish, (Clarion)	30	8	246	8	1449.23
Sandstone, light gray, brownish tint, with black streaks, coarse-grained, conglomerate, turning to black shale	1	4	248	0	1447.9
Shale, dark, sandy.....	3	0	251	0	1444.9
Sandstone, very hard, coarse grained, conglomerate, broken, dark gray..	2	0	253	0	1442.9
Slate, dark, intermingled with conglomerate	2	6	225	6	1440.4
Shale, dark.....	2	5	257	11	1437.98
Coal and black slate 1' 2" } (Clarion) ...	2	4	260	3	1435.65
Black slate.....1 2 }					
Shale, dark, becoming sandy in the last 12".....	18	3	278	6	1417.40
Coal 0' 10 " }					
Slate 0 2 }					
Coal, slaty.....0 3 }					
Coal, bony.....0 10½ }					
Slate 0 3 { Lower Clarion ..	3	1	281	7	1412.78
Coal 0 2½ }					
Slate 0 3 }					
Coal, bony.....0 3 }					
Slate	1	6½	283	1½	1411.24
Pottsville Series (90' 11")					
Sandstone, hard, gray, with black streaks at bottom, (Homewood)...	7	6	290	7½	1405.28
Shale, black.....	0	5	291	0½	1404.88
Shale, dark	9	10	300	10½	1395.03
Dark sandy shales with sandstone streaks	33	2	334	0½	1361.87
Hard gray conglomerate sandstone with coal streaks ... 1' 9 " }					
Hard gray sandstone with black specks showing pyrites or silica 13 6½ }	15	3½	349	4	1346.57
(Homewood)					
Fire clay? shale (Mt. Savage).....	4	8½	354	0½	1341.86
Sandstone, dark, fine grained.....	20	0	374	0½	1321.86

The following section was made by Hennen with aneroid in descending along the hill road west of Clifton Mills. The section covers nearly a mile of horizontal distance along the western side of the Kingwood syncline, making the intervals

in the upper part very much greater than true vertical measurements would show:

Section at Clifton Mills, Grant District.

	Thickness Feet.	Total Feet.
Conemaugh Series (155')		
Sandstone, green, fine grained, Buffalo.....	20	20
Shale, black, with fossil shells, Brush creek	24	54
Coal, Brush Creek , 1' 3" (elevation, 1833' L-A. T.).....	1	55
Concealed and sandstone.....	100	155
Allegheny Series (190')		
Coal blossom, (Upper Freeport) (elevation, 1733' B-A. T.).....	0	155
Concealed	45	200
Sandstone, shaly.....	18	218
Fire clay shale.....	5	223
Fire clay, flinty.....	2	225
Shale, black, and sandy.....	10	235
Concealed and sandstone.....	11	246
Coal, Lower Freeport (elevation, 1640' B-A. T.)	4	250
Concealed	40	290
Sandstone	20	310
Concealed	30	340
Fire clay and trace of coal blossom, Lower Kittanning	5	345
Concealed		

PLEASANT DISTRICT.

The following section was made with careful stadia measurement by Dr. F. L. Slocum, geologist for the Hydro-Electric Company of West Virginia, in company with Reger of the Survey. Extensive diggings were made to expose the coals. The section is located along the east side of the gorge of Big Sandy creek, two miles southwest of Rockville. The rocks are dipping westward toward the Ligonier syncline, making the total thickness of the section in excess of true vertical measurement by perhaps 25 feet:

Section 2 Miles Southwest of Rockville, Pleasant District.

	Thickness Feet.	Total Feet.
Conemaugh and Allegheny Series (505.9')		
Sandstone boulders massive, brown, pebbly, Saltsburg, capping knob, and concealed.	64.5	64.5
Coal 2' 2" }		
Shale, dark 0 2 }		
Coal 0 6 }		
2' 10" Bakerstown (elev., 932' B-A.T.)....	2.9	67.4

	Thickness Feet.	Total Feet.
Concealed	38.5	105.9
Coal streaks.....	0	105.9
Concealed and sandstone, flaggy.....	97	202.9
Shale, dark.....	4	206.9
Coal, Brush Creek (elevation, 1791' B-A. T.)	1	207.9
Fire clay.....	10	217.9
Concealed	176	393.9
Coal, soft, rotten, Upper Kittanning (elev., 1602' B-A. T.).....	3	396.9
Concealed	38.5	435.4
Coal, good..1' 0" }		
Slate, black 1 6 } 3' 0" Lower		
Coal, good..0 6 } Kittanning	3	438.4
Concealed, mostly sandstone.....	49	487.4
Iron ore.....	0.5	487.9
Shale, dark.....	1.0	488.9
Coal, Clarion (elevation, 1510' B-A. T.)....	0.5	489.4
Shale, dark	4.0	493.4
Concealed	12.5	505.9
Pottsville Series (335.6')		
Sandstone, Homewood	79	584.9
Concealed	10	594.9
Coal, Tionesta (elevation, 1404' B-A. T.)....	0.5	595.4
Concealed	65	660.4
Concealed, making steep bluff.....67 }		
Upper		
Connoquenessing 129.5		789.9
Sandstone, massive...62.5 }		
Slate, gray.....	15	804.9
Sandstone, massive, Lower Connoquenessing	33.5	838.4
Coal, soft, good..0' 8" }		
Shale, dark.....0 10 }		
Sharon (elevation, 1158' B-A. T.)	3.1	841.5
Coal, hard, good..1 7 }		
Mauch Chunk Series (148')		
Shales, red, with shaly sandstones at base, to Sandy Creek.....	148	989.5

The following section was made by Hennen and Reger along the east side of the Cheat river gorge, about one mile southwest of Nebo church. It starts about 40 feet below the top of a wooded knob where the upper measures are concealed. That portion of the section which includes the Allegheny series was measured with hand-level, but the aneroid was used on the remainder from the Homewood sandstone down to the river. The section is directly on the strike of the rocks, making the vertical intervals practically correct:

Section One Mile Southwest of Nebo Church, Pleasant District

	Thickness Feet.	Total Feet.
Allegheny Series (231')		
Coal horizon, Upper Freeport (elev., 1965' B-A. T.).....	0	0
Unrecorded	49	49
Coal, Lower Freeport (elev., 1910' B-A. T.)..	1	50
Unrecorded	26	76
Coal blossom, Upper Kittanning, (elev., 1884' B-A. T.).....	0	76
Unrecorded	19	95
Limestone, Johnstown cement, thickness concealed	0	95
Unrecorded	46	141
Coal, Middle Kittanning (elev., 1822' B-A. T.)	2	143
Unrecorded	88	231
Pottsville, Mauch Chunk and Greenbrier Series (750')		
Sandstone, cliff rock, Homewood.....	50	281
Coal, thickness concealed, Tionesta (elev., 1684' B-A. T.).....	0	281
Concealed	35	316
Coal, thickness concealed, Upper Mercer (elev., 1649' B-A. T.).....	0	316
Concealed	25	341
Sandstone, pebbly, Upper Connoquenessing..	85	426
Concealed, Pottsville, Mauch Chunk, etc....	530	956
Limestone, Greenbrier, to Cheat river.....	25	981

The following section was measured by Reger with aneroid in descending along the south side of Big Sandy creek at the lower falls:

Section 1.5 Miles Northwest of Rockville, Pleasant District.

	Thickness Feet.	Total Feet.
Allegheny and Pottsville Series (306')		
Sandstone, visible	10	10'
Shale, brown, and concealed.....	5	15
Coal, Lower Kittanning (elev., 1450' B-A. T.)	1	16
Concealed	90	106
Iron ore boulders, in situ (?).....	0	106
Concealed	25	131
Shale, brown	14	145
Slate, black, streaks of coal, Upper Mercer..	1	146
Shale, gray	4	150
Concealed	26	176
Sandstone, massive, Upper Connoquenessing	50	226
Coal, hard, good, 4", Quakertown.....	0	226
Sandstone, massive, Lower Connoquenessing	15	241
Shale, gray, and concealed.....	15	256
Sandstone, massive, flaggy at base, to base of lower falls, Sharon.....	50	306
Slate hard, gray.....	3	309

The following section was made by Reger with aneroid in descending along the hill road immediately south of Rockville, starting at the private road three-fourths mile south of Big Sandy creek. The intervals show true vertical measurement because the section was made along the strike of the rocks:

Section South of Rockville, Pleasant District.

	Thickness Feet.	Total Feet.
Allegheny Series (206')		
Coal, Lower Freeport (elev., 1660' B-A. T.)...	1	1
Concealed	20	21
Sandstone, flaggy	25	46
Concealed and sandstone.....	40	86
Fire clay and shale.....	50	136
Concealed	44	180
Coal blossom, Clarion.....	1	181
Concealed	25	206
Pottsville Series (125')		
Sandstone, massive, gray, pebbly, making overhanging cliff, Homewood.....	50	256
Shale, sandy	5	261
Concealed to Big Sandy creek.....	70	331

The following section was made by Hennen and Reger with hand-level along the south side of Little Sandy creek, one-half mile from its junction with Big Sandy. With the exception of a few members near the top and bottom, the strata were completely exposed by a stripping made under the direction of L. G. Huntley, geologist for the Hydro-Electric Company of West Virginia. The Upper Freeport coal is not exposed, but its horizon belongs just below the Mahoning sandstone. The section was made along the nose of the Preston anticline, making the intervals slightly greater than true vertical measurements would show:

Section 1.5 Miles Northeast of Rockville, Pleasant District.

	Thickness Feet.	Total Feet.
Conemaugh Series (')		
Sandstone, Mahoning, mostly concealed in bluff	...	...
Allegheny Series (254.1')		
Concealed	37	37
Sandstone, makes bluff, Lower Freeport....	42	79
Coal, Upper Kittanning (elev., 1672' L-A. T.)	3	82
Shale, dark and concealed.....	32	114

	Thickness Feet.	Total Feet.
Sandstone, massive, white.....	37	151
Fire clay shale.....	9	160
Sandstone, massive, gray and white.....	11	171
Concealed	21	192
Slate, dark.....	5	197
Fire clay shale.....	21	218
Coal, lenticular, 6".....	0.5	218.5
Shale, dark gray.....	16.5	235
Coal 0' 10" } Clarion		
Shale, gray...1 0 } (elev., 1516' L-A.T.)	2.8	237.8
Coal 1 0 }		
Shale and fire clay.....	14.3	252.1
Shale, dark	2	254.1
Pottsville Series (109')		
Sandstone, Homewood	27	281.1
Shale, dark, and concealed.....	20	301.1
Coal, Tionesta? (elev., 1451' L-A. T.).....	2	303.1
Shale, light gray.....	5	308.1
Concealed	49	357.1
Sandstone, Upper Connoquenessing, to Little Sandy Creek.....	6	363.1

VALLEY DISTRICT.

The following section, published on page 110 of the Monongalia, Marion and Taylor county report of the West Virginia Geological Survey, was made by Hennen with hand-level along the Cheat river gorge south of Beaverhole, near the Monongalia county line. It is republished in this report for convenience of reference:

Beaverhole Section, Valley District.

	Thickness Feet.	Total Feet.
Allegheny Series (271')		
Concealed from summit of hill road 1 mile S 45° W of Beaverhole.....	40	40
Shale	5	45
Coal (20"), Lower Freeport (2014' L-A. T.)..	1.7	46.7
Shale	5.3	52
Concealed	25	77
Sandstone, massive, Lower Freeport, upper division	37	114
Concealed	15	129
Sandstone, massive, gray, hard and pebbly, Lower Freeport	89	218
Concealed	22	240
Sandstone, massive, Clarion.....	10	250
Shale	6	256
Coal 3' 0" } Clarion coal		
Slate, gray.....1 0 } (1800' L-A. T.)..	5	261
Coal 1 0 }		
Concealed	10	271
		10

	Thickness Feet.	Total Feet	
Pottsville Series (314')			
Sandstone, massive, Homewood.....	40	311	
Concealed	40	351	90'
Sandstone, massive, great cliff rock, Upper Connoquenessing	100	451	
Concealed and sandstone.....	62	513	
Sandstone, gray and white, coarse and peb- bly, Sharon.....	62	575	224'
Mauch Chunk Series (226')			
Concealed with sandstone boulders.....	42	617	
Concealed with brown and green sandstone.	104	721	
Sandstone, massive, brown, fine grained....	21	742	
Concealed	5	747	
Sandstone, massive, coarse, gray and white, pebbly, Maxton.....	42	789	
Concealed to road forks (U. S. G. S., 1260' L-A. T.).....	12	801	226'
Greenbrier Limestone (92')			
Concealed	61	862	
Limestone, dark gray, "Big Lime".....	31	893	92'
Pocono Sandstones (296') (top, 1168' L-A. T.)			
Sandstone, massive, coarse and pebbly, gray and brown, Big Injun.....	73	966	
Concealed	203	1169	
Sandstone, bluish green, flaggy, Upper Squaw, to Cheat river level at Beaver- hole (872' L-A. T.).....	20	1189	296'

The following section was made by Reger with aneroid along the hill road immediately northwest of Kane Creek station on the Morgantown and Kingwood railroad. Since the strata dip rapidly westward toward the Ligonier syncline, the intervals are less than true vertical measurements would show:

Kane Creek Section, Valley District.

	Thickness Feet.	Total Feet.
Conemaugh Series (103')		
Sandstone, massive, very pebbly, Buffalo...	15	15
Concealed	10	25
Shale, dark, fossiliferous, Brush Creek.....	3	28
Concealed	10	38
Fire clay, white.....	1	39
Shales and concealed.....	24	63
Sandstone, massive, Mahoning.....	30	93
Shale and concealed.....	10	103
Allegheny Series (120')		
Coal, Upper Freeport, thickness concealed (elev., 2095' B-A. T.).....	...	103
Concealed and shale, ferriferous.....	20	123
Fire clay	1	124

	Thickness Feet.	Total Feet.
Shale, gray	19	143
Coal, streak, Lower Freeport (elev., 2055' B-A. T.).....		143
Concealed, mostly shale.....	10	153
Sandstone	5	158
Concealed	10	168
Shale, dark, streak.....		168
Sandstone and concealed.....	10	178
Coal, Upper Kittanning (elev., 2019' B-A. T.)	1	179
Shale, gray.....	14	193
Slate, black, to M. & K. railroad.....	5	198
Fire clay, white.....	1	199
Concealed to Kane Creek.....	24	223

LYON DISTRICT.

The following section was made by Hennen with aneroid in descending along a steep hill road just south of Martins run of Three Fork creek, two miles southeast of Gladesville:

Section 2 Miles Southeast of Gladesville, Lyon District.

	Thickness Feet.	Total Feet.
Conemaugh Series (313')		
Sandstone, massive, brown, pebbly, capping knob, Grafton	15	15
Concealed	20	35
Shale, red	10	45
Concealed and shaly sandstone.....	15	60
Fire clay, plastic.....	5	65
Concealed	10	75
Fire clay, plastic.....	10	85
Shale	5	90
Sandstone, greenish, medium grained, flag- gy. Saltsburg	40	130
Concealed	35	165
Shale, flinty, red.....	15	180
Shale, sandy	5	185
Concealed	20	205
Fire clay, flinty.....	9	214
Fire clay, plastic.....	1	215
Shale and concealed.....	40	255
Sandstone, Mahoning	47	302
Concealed	7	309
Shale, black, (Uffington).....	4	313
Allegheny Series (4')		
Coal 1' 3" } Upper		
Shale, dark gray, hard..0 1 } Freeport...		
Coal 0 9 }	2	315
Slate and concealed to run.....	2	317

Another section was made by Hennen with aneroid along the north side of Threefork creek, just east of the mouth of Martins run. The section is as follows:

Threefork Creek Section, Lyon District.

	Thickness Feet.	Total Feet.
Conemaugh and Allegheny Series (455')		
Concealed from top of knob (estimated)....	100	100
Shale, very fossiliferous, Ames.....	9	109
Coal, Harlem (elev., 1650' B-A. T.) 18" to..	1	110
Concealed with reds, (Pittsburgh).....	120	230
Concealed	40	270
Concealed, with iron ore fragments.....	10	280
Sandstone, massive, greenish, medium coarse	15	295
Concealed	5	300
Fire clay	5	305
Sandstone, massive, gray and green, medium coarse, Mahoning.....	40	345
Concealed	105	450
Sandstone, coarse, pebbly.....	5	455
		455'

The following section was made by Hennen and Reger directly along the axis of the Evansville syncline at Newburg, the upper portion with hand level just south of the shaft of the Virginia-Maryland Coal Corporation, along the steep hillside. The members of this portion are arranged in descending order and connected directly with a diamond drill record (68) which was furnished the Survey by Dr. F. L. Slocum, geologist for the Hydro-Electric Company of West Virginia. Below the diamond drill hole the section is continued with the lower portion of the record of an oil well (67), drilled many years ago by J. M. Guffey, the record of which was furnished by Prof. John F. Carll, and which was published complete in Vol. I(A), page 342, of the Survey reports. Both the diamond drill hole and the oil well are located near the coal shaft, so that there was no uncertainty in connecting them. Since the entire section is on the strike of the rocks it shows true vertical measurements:

Newburg Section, Lyon District.

	Thickness Feet.	Total Feet.
Monongahela Series (77')		
Sandstone, coarse brown, soft, Upper Pittsburgh	50	50

	Thickness Feet.	Total Feet.	
Coal, shaly....1' 6" }			
Shale, gray....0 6 }			
Coal 9 6 }			
Shale, gray....0 6 }			
Slate, black...6 0 }	Pittsburgh 27 (Elev., 1691' L-A. T.)	77	77'
Fire clay.....1 0 }			
Coal, slaty....1 6 }			
Shale, gray....4 6 }			
Coal 2 0 }			
Conemaugh Series (641')			
Shale and concealed.....	255.5	332.5	
Coal, Elk Lick, reported (elev., 1431.5' L-A. T.).....	4	336.5	
Concealed	16	352.5	
Sandstone, coarse, brown, pebbly, Grafton..	30	382.5	
Concealed	16	398.5	
Sandstone, flaggy, Grafton.....	10	408.5	
Shale, sandy	5	413.5	
Shale, black, fossil shells, Ames.....	15	428.5	
Coal, Harlem, 16" (elev., 1338' L-A. T.).....	1.5	430.0	
Fire clay shale.....	5	435.0	
Shale, reddish brown.....	25	460.0	
Sandstone, shaly, Saltsburg.....	8	468.0	
Shale, reddish brown.....	15	483.0	
Concealed	12	495	
Coal, digging, Bakerstown (elev., 1271' B-A. T.).....	2	497	
Concealed to bore hole at shaft.....	71	568	
Diamond Drill Hole Record (68) (elev., 1200' B-A. T.)			
Surface	8	576	
Sandstone, Buffalo	35	611	
Soapstone, (water)	24	635	
Slate	1	636	
Coal, Brush Creek, 5" to.....	2	638	
Sandstone, heavy water at base, (Mahoning)	80	718	641'
Allegheny Series (235')			
Coal 3' 0" }	Upper Freeport... 6	724	
Slate 0 8 }			
Coal 2 4 }			
Soapstone	2	726	
Fire clay, (Bolivar).....	7	733	
Sandstone	1	734	
Soapstone	18	752	
Limestone, (Upper Freeport).....	8	760	
Soapstone	6	766	
Iron ore (11").....	1	767	
Soapstone	4	771	
Fire clay (Lower Freeport coal horizon)...	2	773	
Soapstone	15	788	
Soapstone, dark in color.....	11	799	
Slate and soapstone.....	1	800	
Slate and soapstone, mixed with sand....	8	808	
Sandstone	2	810	
Slate	14	824	

	Thickness Feet.	Total Feet.	
Slate, with white streak in it.....	2	826	
Slate	18	844	
Sandstone 26' }			
Sandstone with black streaks... 6 } Lower Freeport....	41	885	
Sandstone 9 }			
Slate	0.5	885.5	
Coal and slate...1' 6" } (Middle			
Coal 2 0 } Kittanning)	3.5	889	
Soapstone	15	904	
Coal 7' 6" } (Lower			
Slate 0 10 } Kittanning)	9.5	913.5	
Coal 1 2 } (elev., 854.5' B-A. T.)			
Unrecorded	0.5	914	
Sandstone	5	919	
Sandstone, hard and fine. (Clarion).....	18	937	
Unrecorded	11	948	
Slate and sandstone, mixed.....	5	953	235'
Pottsville Series (305')			
Sandstone, Homewood.....	89	1042	
Slate	7	1049	
Coal, (Tionesta) (10").....	1	1050	
Soapstone	2	1052	
Slate	5	1057	
Coal 0' 3" }			
Slate 2 5 } Upper Mercer.....	3	1060	
Coal 0 4 } (elev., 708' B-A. T.)			
Slate	11	1071	
Sandstone, very hard, in thin layers.....	5	1076	
Virginia-Maryland Coal Corporation well (67)			
Sandstone, gray, very hard (Upper Conno-			
quennessing)	62	1138	
Slate (8" casing, 616').....	15	1153	
Sandstone, gray. (Lower Connoquennessing)..	30	1183	
Slate and shale.....	55	1238	
Sandstone, gray, (Sharon).....	20	1258	305
Mauch Chunk Series (390')			
Slate and shale.....	30	1288	
Red rock	100	1388	
Slate and shale	30	1418	
Lime, white.....	40	1458	
Red rock	120	1578	
Slate and shale.....	25	1603	
Red rock	10	1613	
Slate and shale.....	35	1648	390'
Greenbrier Series (65')			
Lime, dark, (Big).....	60	1708	
Slate, black.....	5	1713	65'
Pocono Series (415')			
Sandstone, gray.....118' }			
Slate 10 } (Big Injun)..	148	1861	
Sandstone, red (6% "			
casing, 1317')..... 20 }			
Slate and shale.....	20	1881	

	Thickness Feet.	Total Feet.	
Sandstone, gray, (Squaw).....	137	2018	
Slate and shale.....	90	2108	
Sandstone, gray, (Berea).....	20	2128	415'
Catskill Series (711')			
Slate, soft.....	10	2138	
Lime	15	2153	
Slate and shale.....	10	2163	
Sandstone, gray.....	15	2178	
Slate	10	2188	
Sandstone, gray.....	10	2198	
Slate and shale.....	195	2393	
Red rock	180	2573	
Slate and shale.....	10	2583	
Red rock	256	2839	711'
Chemung Series (703')			
Slate and shale.....	49	2888	
Sandstone, gray	30	2918	
Slate and shale to bottom.....	624	3542	703'

KINGWOOD DISTRICT.

The following section was made along the axis of the Kingwood syncline, just southwest of Albright. The upper members were secured from outcrops in Copeman knob, while the lower portion, from the Connellsville sandstone downward, was made with hand-level by Reger on the steep Cheat river hill directly facing the town. The section fails to include the Upper Freeport coal which at this point should be about 80 feet below the level of Cheat river:

Albright Section, Kingwood District.

	Thickness Feet.	Total Feet.	
Monongahela Series (61')			
Concealed from top of Copeman Knob (estimated)	50	50	
Pittsburgh coal (reported) (1745' B-A. T.)..	11	61	61'
Conemaugh Series (533')			
Interval, containing boulders of Connells- ville sandstone	130	191	
Coal, (supplied from crop along road to south), Little Clarksburg.....	1.5	192.5	
Concealed	113.5	306	
Sandstone, hard, gray, fine grained, Grafton	50	356	
Shale, sandy	14	370	
Shale, dark, green, fossiliferous, Ames.....	20	390	
Coal, (supplied from Snyder mine), Har- lem (2' 3").....	2	392	
Concealed	52	444	

	Thickness Feet.	Total Feet.
Shale, brown.....	5	449
Sandstone, Saltsburg, massive, hard, coarse. pebbly, mottled with iron oxide spots..	34	483
Limestone, hard	2	485
Shale, dark, with ferriferous limestone nug- gets	15	500
Concealed	5	505
Coal, thickness concealed, Bakerstown (elev., 1269'; hand level).....	0	505
Limestone, hard, Albright.....	2	507
Shale, gray, with gastropod fossils.....	2	509
Concealed	27	536
Sandstone, massive, hard, gray, shaly at top, Buffalo	25	561
Shale, gray, with boulders of iron carbonate	2	563
Concealed to Cheat river.....	31	594
		533'

The following section was made by Hennen with aneroid in descending order, starting at the road fork, 1.5 miles south-west of Trowbridge, and working northeast to Cheat river at the mouth of Lick run. Owing to the rapid southward rise of the rocks along the axis of the Kingwood syncline the intervals are much greater than true vertical measurement would show:

Trowbridge Section, Kingwood District.

	Thickness Feet.	Total Feet.
Conemaugh and Allegheny Series (510')		
Concealed, mostly sandstone.....	35	35
Shale, sandy, and dark, with marine shells, Ames	20	55
Concealed	15	70
Coal blossom, Harlem (elev., 1770' B-A. T.)..	0	70
Shale and concealed.....	85	155
Sandstone, massive, coarse, mottled with iron oxide, making boulders, Saltsburg.....	20	175
Coal, Bakerstown (4' 10") (supplied from Gibson mine)	5	180
Fire clay	3	183
Concealed	7	190
Shale, sandy	25	215
Concealed	15	230
Coal blossom, trace (elevation, 1590' B-A. T.)...	...	230
Concealed	25	255
Sandstone, massive, cliff rock, Buffalo.....	45	300
Concealed	5	305
Coal blossom, Brush Creek (elev., 1510' B-A. T.).....	1	306
Shale, sandy	9	315

	Thickness Feet.	Total Feet.
Coal, slaty, 5".....	1	316
Fire clay and shale.....	24	340
Concealed	15	355
Shale, sandy	20	375
Concealed	20	395
Fire clay, good, dark gray, Bolivar.....*	10	405
Concealed to Lick run road.....	60	465
Sandstone, massive, making falls.....	40	505
Slate, black, coaly 2' 0" }		
Shale, gray.....1 6 }		
Coal 1 3 }		
Shale, gray.....0 1 }		
Coal 0 3 }		
Slate, black.....0 1 }		
Coal 0 2 }		
Shale and concealed to Cheat river.....	25	535
Upper Kittanning... (5' 4")		510

PORTLAND DISTRICT.

The following section is composed mainly of the records of two core tests drilled by J. F. Stoer, of Philadelphia, Pa., on his property about 1.7 miles north 25° east of Manheim, on the head of Bearwallow run, the records of which were furnished the Survey by E. S. Felton, under whose direction they were drilled. As shown on Map II, the tests were made on the steep structural slope of the Briery Mountain and Etam anticlines. The difference of elevation between the two wells shows that No. 2 (Map No. 82) was drilled to a depth of 8½ feet below the top of well No. 1 (Map No. 83). Since there is probably a rise of about 60 feet of structural level between the two wells, an allowance of 50 feet was made between them in the section as published below, which makes a total allowance of 58½ feet for the rise of the measures. While this method is only an approximation, it gives almost the same thickness for the Pottsville series as shown by the Rowlesburg section:

Manheim Section, Portland District.

Top portion contained in record of J. F. Stoer Core Test No. 2 (Map No. 82); (elevation of top. 2250' B-A. T.)

	Thickness		Total
Allegheny Series (75')	Ft.	In.	Ft. In.
Surface and soft shale.....	13	0	13 0
Calcareous shale.....	18	0	31 0
Conglomerate ...24' 6" }			
Sandstone 11 0 }			
Clarion sandstone ..		35 6	66 6

	Thickness	Total	
	Ft. In.	Ft. In.	
Dark shale, (Clarion coal).....	8 6	75 0	75'
Pottsville Series (328' 9")			
Crystallized sand- stone 2' 6" } Homewood	65 0	140 0	
Sandstone 62 6 }			
Dark shale.....	2 6	142 6	
Fire clay, Mt. Savage.....	12 6	155 0	
Dark shale	5 0	160 0	
Hard sandstone to bottom.....	3 6	163 6	
Interval between core tests, due to southeastward rise of rocks, about..	50 0	213 6	
(Bottom portion contained in record of J. F. Stoer Core Test No. 1) (Map No. 83); (elev. of top, 2095' B-A. T.)			
Earth, sandstone and dark shale.....	42 6	256 0	
Fire clay	12 0	268 0	
Coal, (Quakertown)	0 1	268 1	
Fire clay	13 6	281 7	
Dark shale	6 0	287 7	
Black slate	5 5	293 0	
Fire clay	1 5	294 5	
Coal	0 1	294 6	
Fire clay.....	4 0	298 6	
Dark shale and fire clay.....	25 0	323 6	
Coal, (Sharon)	1 3	324 9	
Fire clay	6 0	330 9	
Dark shale	38 0	368 9	
Fire clay	6 0	374 9	
Conglomerate (Sharon)	16 0	390 9	
Fire clay	13 0	403 9	328' 9"
Mauch Chunk Series (163' 1")			
Blue shale	5 3	409 0	
Red shale	10 0	419 0	
Blue shale	8 0	427 0	
Red shale.....	4 3	431 3	
Blue shale	9 4	440 7	
Red shale	3 3	443 10	
Blue shale	5 4	449 2	
Red shale	6 9	455 11	
Light sandstone	42 4	498 3	
Blue stone	20 7	518 10	
Blue sandstone to bottom.....	48 0	566 10	

The following section was made by Hennen with aneroid in descending order down the steep mountain road northwest of Amblersburg. Since there is a very rapid rise of the rocks southeastward toward the Briery Mountain anticline, the intervals are very much shorter than true vertical measurements would show. The junction between the Catskill and Chemung series belongs in the 150 feet of concealed interval at the bottom of the section:

Amblersburg Section, Portland District.

<i>Upper Carboniferous</i>	Thickness	Total	
Pottsville Series ()	Feet.	Feet.	
Sandstone, gray and white, conglomeratic, capping Briery Mountain, thickness un- determined			...
<i>Lower Carboniferous (495')</i>			
Mauch Chunk Series (170')			
Shale, red and red sandstone.....	15	15	
Sandstone, shaly, green.....	15	30	
Slate, red	15	45	
Sandstone, green, fine, shaly.....	55	100	
Concealed	5	105	
Shale, red	5	110	
Sandstone, green, flaggy, fine.....	10	120	
Concealed	45	165	
Shale, red	5	170	170'
Greenbrier Limestone (105')			
Limestone, gray and hard.....	50	220	
Concealed	40	260	
Limestone, gray and hard.....	15	275	105'
Pocono Series (220')			
Sandstone, massive.....	15	290	
Sandstone, concealed, and sandstone, very coarse and pebbly.....	160	450	
Shale and concealed.....	15	465	
Sandstone, greenish.....	30	495	220'
<i>Devonian (475')</i>			
Catskill and Chemung Series (475')			
Shale, red, sandy, concealed, and red shale..	50	545	
Sandstone, shaly, red.....	20	565	
Concealed	30	595	
Shale, red	10	605	
Concealed	35	640	
Shale, red	5	645	
Sandstone, green at bottom, red at top, flaggy	45	690	
Shale, red and sandy.....	45	735	
Sandstone, flaggy, reddish.....	5	740	
Concealed	15	755	
Shale, red	10	765	
Sandstone, flaggy	55	820	
Concealed to Spruce creek.....	150	970	

RENO DISTRICT.

The following section was made by Hennen and Reger, along the Baltimore & Ohio railroad, between Anderson and Rowlesburg, covering a horizontal distance of about four miles. For the entire distance over which the section was measured the rocks are rising steadily toward the Etam anti-



PLATE VII.—View of Rowlesburg, looking west, showing topography of the Chemung, Catskill and Pocono rocks.
Photo by E. E. Knight

cline to the southeast, at angles varying from 2 to 15 degrees. The vertical difference between the top and bottom of the section is only about 400 feet, but the rise of the rocks exposes 3002 feet of the measures. Careful stadia measurement was made along the entire length of the section and observations were made with both the clinometer and the transit at numerous points to determine the rise of the rocks. The entire section was then reduced by trigonometric formulae to secure the actual thickness of the formations so that it gives a close approximation to true vertical measurement

Rowlesburg Section, Reno District.

		Thickness	Total
		Feet.	Feet.
Allegheny Series (241')			
Coal, bony.....0' 10"	} Upper Freeport bed.		
Coal, soft.....2 0			
Slate, gray.....0 3			
Coal, bony 1 10		6	6
Slate, black.....0 1			
Coal, 10" to.....1 0			
Fire clay.....		1	7
Sandstone and shale.....		16	23
Shale, green, sandy.....		5	28
Limestone, gray and hard 1' 6"	} Upper Freeport Limestone ...		
Shale, gray, limy, with iron ore nuggets 6 0		14.5	42.5
Limestone, gray and hard silicious, with shale layers.....7 0			
Fire clay shale.....		4	46.5
Fire clay, flinty (Lower Freeport coal horizon)		8	54.5
Fire clay with dark shale at top.....		5	59.5
Sandstone, limy and shaly.....		2	61.5
Sandstone, massive.....		3	64.5
Shale, gray		4	68.5
Concealed		52.5	121.0
Sandstone		2	123
Concealed		1	124
Shale, gray		5.2	129.2
Coal 0' 3"	} Upper Kittanning ..		
Shale, gray.....0 5			
Coal 0 6		2.7	131.9
Shale, gray.....1 2			
Coal 0 4			
Concealed		51.1	183
Fire clay, plastic, with flinty layers.....		15	198
Fire clay, with nodular, ferriferous limestone (Lower Kittanning).....		7	205

	Thickness Feet.	Total Feet.		
Sandstone, shaly.....	3	208		
Shale, silicious	1	209		
Limestone, silicious, ferriferous, nodular, Vanport	1	210		
Shale, brown, silicious.....	4.7	214.7		
Sandstone, flaggy	0.3	215		
Coal, Upper Clarion	1	216		
Shale, dark gray.....	8	224		
Sandstone, flaggy, shaly, finely laminated...	7	231		
Coal, good.....1' 1" }	Lower Clarion Coal..	10	241	241
Slate, black.....0 1½				
Coal				
Shale, gray.....2 5½				
Coal, bony.....0 2				
Shale, gray.....2 5				
Coal, bony.....1 7	}			
Coaly slate, hard..1 7				
Pottsville Series (330')				
Sandstone, massive, white, Homewood.....	28	269		
Shale, dark, silicious.....	5	274		
Fire clay, indurated with plant fossils.....	1	275		
Coal	Tionesta Coal..	4	279	
Shale, dark.....3 1				
Coal				
Shale, dark	3	282		
Sandstone, massive, dark gray, medium grained, micaceous	34	316		
Shale, black, with iron ore nodules and thin ferriferous limestone	7.2	323.2		
Coal, Upper Mercer.....	0.8	324		
Shale, black, laminated.....	5	329		
Shale, silicious	21	350		
Sandstone, massive.....	2	352		
Shale, black, finely laminated.....	2.5	354.5		
Coal, slaty.....0' 3" }	(10") Lower Mercer	1	355.5	
Slate, black.....0 2				
Coal, good.....0 5				
Shale	3.5	359		
Sandstone, massive, gray and coarse, Upper Connoquenessing	78	437		
Coal	Quakertown ...	5.7	442.7	
Shale, soft, brown....4.7				
Coal				
Shale green, brown, and silicious.....	7.3	450		
Limestone, ferriferous, 5' to.....	1	451		
Shale, dark, silicious, finely laminated....	6	457		
Coal, bony.....0' 5" }	2	459		
Coal, soft	1 7 }			
Shale, gray, laminated.....	10	469		
Shale, silicious, with numerous small iron ore nuggets.....	10.7	479.7		
Coal, soft	0.3	480		
Shale, silicious, yellow and brown.....	6	486		
Shale dark, silicious, finely laminated.....	3	489		

	Thickness Feet.	Total Feet.	
Limestone, very silicious.....	2	491	
Shale, green, silicious.....	3	494	
Slate, black, cannelly.....	0.8	494.8	
Shale, dark green, finely laminated.....	4.2	499	
Slate, black, silicious, finely laminated.....	5.6	504.6	
Coal, soft, Sharon.....	0.4	505	
Shale, dark, silicious, finely laminated, with iron ore nuggets.....	15	520	
Sandstone, massive, white and brown, con- glomerate, with 5' of shale near middle, Sharon	51	571	330'
Mauch Chunk Series (349')			
Concealed	66	637	
Shale, red	5	642	
Sandstone, green, micaceous, fine, massive..	50	692	
Shale, red	10	702	
Sandstone, shaly	8	710	
Concealed and red shale.....	31	741	
Sandstone, massive, green, fine grained, mi- caceous	43	784	
Limestone, nodular, with shale layers.....	6	790	
Shale, red and green.....	46	836	
Concealed	28	864	
Shale, red	5	869	
Limestone, gray, silicious. 8' }	19	888	} Little Lime..
Shale, limy..... 9.5' }			
Limestone, gray silicious. 1.5' }	20	908	
Shale, red			
Sandstone, greenish gray, fine, micaceous...	12	920	349'
Greenbrier Limestone (154')			
Limestone, gray and hard, marine fossils...	95	1015	
Concealed	33	1048	
Sandstone, limy.....	15	1063	
Shale, red.....	5.5	1068.5	
Limestone	1.5	1070	
Shale, red.....	4	1074	154'
Pocono Sandstones (527')			
Sandstone, massive, limy at top, Big Injun..	213	1287	
Sandstone, flaggy, limy, with thin gray shale layers	53	1340	
Concealed	12	1352	
Sandstone, massive, Squaw.....	30	1382	
Shale, dark	35	1417	
Sandstone, massive	30	1447	
Shale, gray, limy.....	2	1449	
Sandstone, massive, limy at top, shaly at base	37	1486	
Shale, limy, with limestone and flaggy sand- stone layers	12	1498	
Sandstone, massive	20	1518	
Shale, silicious and limy, with thin sand- stones	28	1546	
Sandstone, massive, dark gray, medium grained	17	1563	
Shale, gray, limy.....	12	1575	

		Thickness	Total
		Feet.	Feet.
Sandstone, nodular, limy.....	3	1578	
Shale, gray, silicious.....	8	1586	
Sandstone, massive at top, shaly at base (Berea?)	15	1601	
Devonian (1401')			
Catskill Series (601')			
Shale, red	10	1611	
Sandstone, massive, ("Gantz?").....	60	1671	
Sandstone, gray, hard, micaceous ("Fifty- foot")	38	1709	
Shale, red	3	1712	
Sandstone, shaly.....	33	1745	
Shale, red	8	1753	
Sandstone, massive, reddish gray, with shale at middle	56	1809	
Shale, red	6	1815	
Sandstone, shaly	5	1820	
Shale, red	29	1849	
Sandstone, greenish, fine, limy.....	12	1861	
Shale, red.....	31	1892	
Sandstone, green, fine, micaceous.....	20	1912	
Shale, red, and thin sandstones alternating..	50	1962	
Shale, red	6	1968	
Sandstone, fine	7	1975	
Shale, red	4	1979	
Sandstone, fine.....	5	1984	
Shale, red	5	1989	
Sandstone, shaly, fine, red.....	20	2019	
Shale, red	5	2024	
Concealed	96	2120	
Shale, red	10	2130	
Sandstone	10	2140	
Shale, red	28	2168	
Sandstone, green, brown, fine.....	25	2193	
Shale, red	8	2201	
Chemung Series (801')			
Sandstone, green, gray, fine.....	50	2251	
Shale, gray, limy.....	10	2261	
Sandstone, green, gray, micaceous, with plant fossils at base.....	40	2301	
Shale, gray	4	2305	
Sandstone, green, gray, silicious, hard.....	8	2313	
Shale, gray	10	2323	
Sandstone, massive, fine.....	4	2327	
Shale, gray	8	2335	
Concealed	57	2392	
Sandstone, massive	10	2402	
Shale olive brown	60	2462	
Sandstone, with shale layers and ripple marks	15	2477	
Shale, yellowish green, conchoidal fracture..	5	2482	
Concealed	42	2524	
Concealed, with sandstone boulders.....	52	2576	
Concealed	117	2693	
Shale, yellowish green.....	15	2708	

	Thickness Feet.	Total Feet.
Concealed	63	2771
Sandstone, olive green.....	2	2773
Shale, olive green.....	37	2810
Concealed	61	2877
Shale, sandy, brown	8	2885
Sandstone, flaggy and shaly.....	4	2889
Shale, dark, gray.....	10	2899
Shale, brown	6	2905
Sandstone, bluish gray	6	2911
Shale	3	2914
Sandstone, bluish gray, limy, with fossil shells	25	2939
Shale, gray, "oil pay" once.....	5	2944
Sandstone, bluish gray and hard, fine grain- ed, micaceous, quarry rock, with numer- ous plant fossils and strong oil smell, Rowlesburg Sandstone.....	18	2962
Concealed to Cheat river at Rowlesburg....	40	3002

UNION DISTRICT.

The following section was made by Reger with aneroid in descending order down a steep mountain road immediately northwest of Madison Run Station on the Rowlesburg and Southern railroad. The rocks in this locality are almost level, so that the intervals show nearly true vertical measurements:

Madison Run Section, Union District.

	Thickness Feet.	Total Feet.
Catskill Series (320')		
Shale, red	50	50
Sandstone, flaggy	10	60
Shale, red, with thin sandstones.....	130	190
Shale, pale green.....	3	193
Shale red, with thin sandstones.....	127	320
(Base of series, 2135' B-A. T.)		
Chemung Series (696')		
Sandstone, soft, greenish brown, conglomer- ate	30	350
Concealed, with sandstone streaks, making brown soil	135	485
Sandstone, olive green, flaggy, fine, with streaks of shale and conglomerate....	95	580
Concealed, with streaks of sandstone.....	40	620
Shale, olive green.....	10	630
Sandstone, conglomerate	5	635
Shale, olive green	30	665
Sandstone, flaggy	5	670
Shale, olive brown, with thin sandstones and streaks of red.....	60	730

	Thickness Feet.	Total Feet.
Sandstone, dark red.....	1	731
Shale, olive green, with thin sandstones....	89	820
Shale, yellow, with concretions and plant fossils	3	823
Sandstone, soft	5	828
Shale, olive green, silicious.....	72	900
Sandstone, olive green	2	902
Shale, olive green	8	910
Sandstone	2	912
Shale, reddish brown	3	915
Sandstone, shaly	5	920
Shale, olive green and concealed.....	55	975
Concealed, containing rounded boulders, to Cheat river	40	1015

The following section was made by Hennen with aneroid in descending order along the Northwestern Turnpike between Dayton and Hardesty. The section extends over a horizontal distance of 2.5 miles. In the upper part of it the strata are dipping eastward toward the Mount Carmel syncline, while in the lower part they are dipping westward toward the syncline at Erwin. The extreme southern end of the Briery Mountain anticline crosses the road between these two synclines and makes a slight hump in the rocks. Under these conditions it is apparent that intervals in the upper part of the section are too short, while in the lower part they are too great. The dip of the rocks on each side of the anticline is so balanced that it is probable that the sum of the section represents fairly well the thickness that true vertical measurements would show:

Hardesty Section, Union District.

	Thickness Feet.	Total Feet.
Pocono Sandstones (365')		
Concealed, with pebbles	40	40
Sandstone, gray, white and massive at top; light green and flaggy at bottom.....	145	185
Concealed	90	275
Sandstone, massive, reddish, micaceous and very hard	15	290
Concealed	20	310
Sandstone massive, broken.....	15	325
Concealed	25	350
Sandstone, green, fine, Berea? (base of series, 2365' B-A. T.).....	15	365
Catskill Series (690')		365'
Concealed and red shales.....	20	385

	Thickness Feet.	Total Feet.
Sandstone, green, flaggy bottom. massive and red top	30	415
Concealed	20	435
Concealed and red shale.....	20	455
Sandstone, massive.....	10	465
Shale, red, and concealed.....	35	500
Sandstone, reddish gray.....	15	515
Concealed	60	575
Sandstone	5	580
Concealed and red shale.....	25	605
Shale, red and green, alternating.....	25	630
Sandstone, very flaggy (flags ½" to 1") red- dish gray	45	675
Concealed	5	680
Sandstone, massive, hard, medium grain...	25	705
Concealed to bend of road.....	45	750
Sandstone, broken	10	760
Shale, red	5	765
Sandstone, massive, hard.....	50	815
Shale, gray	5	820
Sandstone, massive, green, fine, with quartz in three layers, and red shale layers...	65	885
Concealed	60	945
Sandstone	5	950
Shale, sandy, red.....	35	985
Sandstone, dark reddish gray	10	995
Shale, green and brown.....	10	1005
Sandstone, green, hard, massive, with beau- tiful ripple marks on top.....	20	1025
Concealed and shale, sandy (1').....	15	1040
Slate, red	15	1055
Chemung Series (148')		
Concealed, with hard flaggy sandstone boul- ders, containing many forms of marine invertebrate fossils	50	1105
Sandstone, olive green.....	5	1110
Shale, bluish	5	1115
Concealed	35	1150
Sandstone, massive, olive green, fine grained and hard	5	1155
Concealed and shale, bluish.....	5	1160
Sandstone, massive	5	1165
Concealed	20	1185
Sandstone, massive, hard and fine.....	10	1195
Concealed to road fork at Hardesty (U. S. G. S. 1482')	8	1203

SUMMARY OF GENERAL SECTIONS.

For convenience of reference the thickness of the stratified rocks in Preston county, as determined by the sections in this chapter, is compiled in the following table. The table shows the thickness of the various series and also gives the total for the Upper Carboniferous, Lower Carboniferous, and Devonian rocks. A line of dots under a series indicates that the series was not exposed where the section was made. A question mark indicates that the series was present but could not be separated from the series overlying or underlying it. In some instances the sections show thicknesses for the series either too great or too small, owing to the dip of the measures where they were made. In many cases they show only a part of a series where the remainder was not exposed. An explanation accompanies each section, where published in full, that explains the peculiar conditions under which it was made:

Table Showing Thickness of the Stratified Rocks in Preston County.

PLACE MEASURED	UPPER CARBONIFEROUS					LOWER CARBONIFEROUS					DEVONIAN			Total Section
	Monon- gahela	Cone- maugh	Alle- gheny	Potts- ville	Total	March Chunk	Green- brier	Pocono	Total	Cats- kill	Che- mung	Total		
Ambersburg	...	...	...	...	...	...	...	...	...	(?)	(?)	475	970	
Albright	61	533	...	...	594	...	...	220	495	...	...	...	594	
Beaverhole	...	...	271	314	575	226	92	296	...	...	...	...	1189	
Brandonville	...	...	283.1	90.9	374	...	...	...	...	...	...	...	374	
Clifton Mills	...	155	190	...	345	...	...	...	...	...	...	...	345	
Gladesville	...	313	4	...	317	...	...	...	...	...	...	...	317	
Hardesty	...	103	120	...	223	...	...	365	365	630	208	838	1203	
Kane Creek	...	...	...	...	...	...	...	...	...	320	695	1015	223	
Madison Run	...	...	75	328.8	566.8	163.1	...	...	...	...	...	...	566.8	
Manheim	...	...	231	(?)	(?)	(?)	...	...	...	...	...	...	981	
Nebo Church	77	641	235	305	1258	390	65	485	940	641	703	1344	3542	
Newburg	...	50	260	130	440	...	...	...	...	...	...	...	440	
Rockville, north of	...	100	243	256.1	599.1	7.2	...	...	...	...	...	...	606.3	
Rockville, 1 m. NE	...	...	254.1	109	281.1	...	...	...	...	...	...	...	281.1	
Rockville, 1.5 m. NE	...	...	206	125	331	...	...	...	...	...	...	...	331	
Rockville, south of	...	...	(?)	(?)	841.5	148	...	...	...	...	...	...	989.5	
Rockville, 2 m. SW	...	(?)	(?)	(?)	306	3	...	...	...	...	...	...	309	
Rockville, 1.5 m. NW	...	...	(?)	(?)	385	...	...	...	...	...	...	...	385	
Rockville, 1.8 m. NW	...	15	230	140	371	349	154	527	1030	601	801	1401	3002	
Rowlesburg	...	...	241	330	571	...	...	...	...	...	...	...	455	
Threefork Creek	...	(?)	(?)	...	455	...	...	...	...	...	...	...	455	
Trowbridge	...	(?)	(?)	...	535	...	...	...	...	...	...	...	535	

CHAPTER V.

STRATIGRAPHY—THE MONONGAHELA SERIES.

GENERAL ACCOUNT AND SECTION.

The Monongahela series, which, with the exception of unimportant deposits of Quaternary clays and gravels, is the most recent series of rocks now existing in Preston county, is a subdivision of the Upper Carboniferous. It begins at the top with the Waynesburg coal and extends down to the bottom of the Pittsburgh bed. It varies in thickness from 260 feet in the northern panhandle of West Virginia to 435 feet in southeastern Doddridge and southwestern Harrison counties. The Pittsburgh coal, which is the most important member of the series, thickens gradually from west to east and hence its value is materially increased, since in the eastern part of the State the mining section is thicker than in Marion and Monongalia counties, while its sulphur contents are less.

General sections, showing the typical composition of the Monongahela series along the Monongahela river in West Virginia, as compiled by Hennen, were published in the Doddridge-Harrison county report, page 179, and the Monongalia-Marion-Taylor report, page 216, to which the reader is referred for details, since only the lower part of the series is present in Preston county.

The Monongahela series now exists at only two localities in Preston county; one of them is in the vicinity of Newburg, along the Baltimore and Ohio railroad in Lyon and Reno districts, where the tops of the hills, north and south of Newburg along the axes of the Ligonier and Evansville synclines, are capped with the lower part of the series. A planimeter measurement, made on Map II, shows that only 1.59 square miles

of the series is still left uneroded in this structural depression, the maximum thickness being about 120 feet.

The other locality where the Monongahela series still remains is in the region immediately southwest of Albright, in Kingwood district, where only a few acres of these rocks are found in Copeman knob, the maximum thickness being about 70 feet.

DESCRIPTION OF FORMATIONS.

Inasmuch as the upper portion of the Monongahela series is not found in Preston county only the members that compose the lower part of the series will be described in this report. A complete description of the entire series is published in the county report for Monongalia, Marion and Taylor counties, immediately west of Preston, as well as in numerous previous reports. Reference to these sections shows that at Newburg, where the maximum thickness is found, the Upper Sewickley sandstone should appear in a few of the hill tops. This formation was not observed nor was any outcrop of the Sewickley coal, Sewickley limestone, Redstone coal or the Redstone limestone.

The Upper Pittsburgh Sandstone.

The Upper Pittsburgh sandstone, the highest member of the Monongahela series visible at outcrop in Preston county, was named by H. D. Rogers from its close association with the Pittsburgh coal below it. It is usually soft, coarse grained, but not pebbly, and light gray in color. The Newburg section, published in Chapter IV, shows that this sandstone is 50 feet thick and soft. This great thickness has been the means of preserving several valuable deposits of Pittsburgh coal in that region which without such protective covering would have been eroded from the hill tops.

The Pittsburgh Coal.

The **Pittsburgh coal**, which is the lowest member of the Monongahela series, was named and described by J. P. Lesley from its excellent development at Pittsburgh, Pa., where it has

long been mined extensively. The coal was minutely described later by J. J. Stevenson in Report K, Second Geological Survey of Pennsylvania, and by I. C. White in Volume II, page 164, of the West Virginia reports. The Pittsburgh coal is distinguished from almost all other West Virginia coals by its great regularity of structure and uniform purity of composition. In Preston county its structure is changed to some extent from that found in the Monongahela valley, by the appearance of additional streaks of coal below the usual mining section. The Newburg section, published in Chapter IV, shows a total thickness of 27 feet. Of this the upper 11' 6" corresponds closely to the coal as it appears in many places in western Pennsylvania and along the Monongahela valley in West Virginia except that the three bands that are usually found near the middle of the 9' 6" of the mining section are not always present. The lower 15' 6" is composed of alternate layers of coal and slate or shale, that are worthless for mining purposes, and that are not found west of the Chestnut Ridge anticline in West Virginia. The presence of additional coal members below the main mining section of the coal is a feature that is often found in eastern West Virginia and Maryland, and they may possibly represent the Little Pittsburgh coals of northern West Virginia and western Pennsylvania.

The following section of the coal was measured by Hennen about one mile southward from Newburg:

Hamilton Coal Company Farm Mine.—No. 1 on Map II.

		Ft.	In.
1. Coal, bony, left up, reported.....	1' 6"		
2. Coal	2 10		
3. Bone	0 1		
4. Coal	4 10		
5. Coal, reported.....	0 10	10	7

(Elevation of coal, 1674' L.A. T.)

"Coal is muddy and rusty inside so collected sample from dump, representing Nos. 2, 3 and 4 of section."

The analysis of this coal, as determined in the Survey laboratory is published under No. 1 in the Table of Coal Analyses, at the end of Chapter XII. The coal in this particular locality has been mined extensively for local use and

nothing is left except pillars and crop coal that is inferior to the main body of the coal as it formerly existed. The lack of cover is shown by the presence of mud in the joints of the coal giving it a rusty appearance, and by its soft physical character due to partial disintegration.

The coal is mined in a high hill, 1.5 miles southward from Newburg, where Reger measured the following section:

William Knotts Mine, Pittsburgh Coal.

		Ft.	In.
Sandstone, massive, Upper Pittsburgh capping knob		50	0
Coal, good.....	3' 8 "		
Bone	0 1		
Coal	0 2		
Bone	0 0½		
Coal	0 2		
Bone	0 1		
Coal	4 6	8	8½
Shale			
(Elevation of coal, 1730' B-A. T.)			

The section of the coal, as thus given, shows no essential difference from that of the Monongahela valley, west of the Chestnut Ridge anticline. The three streaks of bone near the middle of the seam, however, are much different from the same members in the Fairmont region, being softer and less readily distinguished from the rest of the coal, and evidently containing a smaller percentage of ash.

The coal is mined for local use in a high hill, 0.7 mile due north of Newburg, where Reger measured the following section:

Pittsburgh Coal Mine, 0.7 Mile North of Newburg.

		Ft.	In.
Sandstone, massive, Upper Pittsburgh, visible..		30	0
Coal, good	4' 3"		
Bone	0 1		
Coal, good	4 0	8	4

(Elevation of coal, 1717' L-A. T.)

The most northern point where the coal was noted along the Ligonier syncline, was at a point two miles northeast of Newburg, where Reger measured the following section:

James Emerson, Farm Mine, Pittsburgh Coal.

		Ft.	In.
Sandstone, massive, Upper Pittsburgh.....			
Coal, good	4' 2"		
Bone	0 1		
Coal	0 5		
Bone	0 1		
Coal, good	4 0	8	9

(Elevation of coal, 1730' B-A. T.)

The Pittsburgh coal was formerly mined extensively on a commercial scale in Scotch Hill, immediately south of Newburg, and was hauled by a gravity incline to the Baltimore and Ohio railroad. The mine was abandoned long ago but the following section, previously published in Volume II of the State reports, was measured by I. C. White in the mine of this company in 1882:

Newburgh Coal Company, Scotch Hill Mine, Pittsburgh Coal.

		Ft.	In.
Sandstone, Pittsburgh.....		35	0
Roof { Coal, slaty.....0' 8" }			
{ Coal 0 9 }	2' 3"		
{ Coal 0 10 }			
Over-clay	2 0		
Breast and brick coal.....	9 0		
Shale	0 3	10	9
Bottom coal, slaty.....	1 6		

"The 'bands' probably exist in the main body of the coal here, but they were not noted when the measurements were made."

Only a small part of the Pittsburgh coal area that still remains uneroded from the hill tops of the Newburg region is now left unmined. Its complete exhaustion is being hastened, not only by mining, but also by a fire that for many years has been raging underground at Scotch Hill.

The Pittsburgh coal has been mined in Copeman knob, 1.2 miles southwest of Albright, along the axis of the Kingwood syncline. The following information was secured by Hennen at this point:

Wm. G. Brown, Farm Mine, Pittsburgh Coal.—No. 2 on Map II.

Coal, Pittsburgh, reported..... 11 feet.
(Elevation, 1730' B-A. T.)

"Could not get section owing to water in mine, but Mr. John Copeman reports it 11 feet thick, only part of which is mined. Collected sample from dump."

The analysis of the coal from this mine, as determined in the Survey laboratory is published under Mine No. 2 at the end of Chapter XII. Since the coal covers only about 20 acres in this knob, it will probably be entirely mined out within a comparatively short time.

CHAPTER VI.

STRATIGRAPHY—THE CONEMAUGH SERIES

GENERAL ACCOUNT AND SECTION.

The Conemaugh series includes that portion of the carboniferous rocks lying between the base of the Pittsburgh coal above, and the top of the Upper Freeport coal below. A general description of this series, by I. C. White, was published in Volume II, pages 225-230 of the State Survey reports.

The Conemaugh series, as observed in Preston county, contains numerous horizons of red shale, several prominent sandstones, seven coal seams, the most of which are too thin for mining, and several thin limestones, which are usually silicious and lenticular, and has a maximum thickness of about 640 feet. The red beds, which are all contained in this upper 450 feet of the series, constitute its most dominant feature. These reds indicate long periods of oxidation, which, according to Dr. White, took place before they were deposited, since the same red sediments are found generally in West Virginia, where borings have been made through the overlying Dunkard and Monongahela series, the conclusion being apparent that the oxidation took place in the contiguous mountain areas from which they came.

The lower 150 feet of the series contains massive sandstones, somewhat similar to those of the Allegheny series below, separated by sandy shales that contain no trace of red.

The topography of the Conemaugh series usually shows two distinct types. In the upper portion, where the red beds predominate, the slopes are usually gentle, making land that is suitable for farming. In the lower portion where the sandstones are prominent the slopes are often precipitous and en-



PLATE VIII.—Village of Eglon looking east. Showing topography of Catskill Series in foreground and Pottsville Series in Backbone Mountain in background.

Photo by E. E. Knight

tirely too rough to be farmed. Valleys are frequently found, in which the surface rocks are all of the Conemaugh series, where the ridges and higher land are in cultivation while the lower portion along the stream is left in woodland, owing to its rough character.

The Conemaugh series is distinguished from the higher measures of the Appalachian region by the occurrence of marine invertebrate fossils, which disappear about 300 feet from the top of the series. There are three limestone horizons, which with the fossiliferous shales that usually accompany them, often contain these fossils in abundance.

The following section, compiled from outcrops noted in many localities throughout the county, gives the general characteristics of the Conemaugh series. The section differs somewhat from those published for the Conemaugh series in previous county reports, being considerably thicker than in the western counties:

General Section of the Conemaugh Series for Preston County.

	Thickness Feet.	Total Feet.
Fire clay and shale.....	5	5
Sandstone, massive, Lower Pittsburgh.....	35	40
Shale, gray.....	9	49
Limestone, Upper Pittsburgh (not found)..<	0	49
Coal, Little Pittsburgh.....	1	50
Fire clay and gray shale.....	19	69
Limestone, Lower Pittsburgh (not found)..<	0	69
Shale, sandy and red.....	40	109
Sandstone, massive, brown, pebbly, Connells- ville	40	149
Coal, Little Clarksburg.....	1	150
Fire clay shale, Clarksburg.....	5	155
Sandstone, massive, mottled with peroxide of iron, lenticular, Lower Connellsville..	20	175
Limestone, gray and hard, Clarksburg, 0' to	5	180
Shale, sandy and red, Clarksburg Reds.....	38	218
Sandstone, massive, lenticular, Morgantown	40	258
Coal, Elk Lick.....	2	260
Fire clay and shale.....	4	264
Limestone, dark gray, Elk Lick.....	5	269
Coal, West Milford, 2" to.....	1	270
Shale, sandy and red, Birmingham.....	10	280
Sandstone, massive, brown, pebbly, Grafton	40	320
Limestone, with marine fossils, Upper Ames	4	324
Shale, dark green, with marine fossils, Ames	15	339
Limestone, with marine fossils, Lower Ames	3	342
Shale, dark.....	6	348

	Thickness Feet.	Total Feet.
Coal, Harlem	2	350
Fire clay and red shale.....	10	360
Limestone, gray, Ewing.....	5	365
Shale, red and variegated, Pittsburgh Reds..	39	404
Sandstone, massive, mottled with peroxide of iron, sometimes pebbly, Saltsburg...	40	444
Limestone.....0 to	2	446
Coal, Bakerstown	4	450
Limestone, Albright.....	2	452
Fire clay shale.....	10	462
Limestone, with marine fossils, Pine Creek.	1	463
Shale, often red.....5 to	15	478
Sandstone, massive, gray, sometimes pebbly. Buffalo.....	40	518
Limestone, with marine fossils, Brush Creek.....1 to	5	523
Shale, black, with plant and marine fossils, Brush Creek.....0 to	26	549
Coal, Brush Creek	1	550
Fire clay shale, with nodules of ferriferous limestone Brush Creek.....	4	554
Sandstone, massive, Upper Mahoning.....	20	574
Coal, not persistent, Mahoning 0 to	1	575
Fire clay, good, not persistent, Thornton 0 to	10	585
Sandstone, gray, Lower Mahoning.....	45	630
Shale, dark, sandy, with plant fossils, Uf- fington.....	10	640
Coal, Upper Freeport		

A considerable variation in the Conemaugh series was found throughout the county, many of the sandstones and limestones being often replaced by sandy shales and the coals being replaced by fire clay. The intervals between the several coals remain fairly constant. In Chapter IV actual measurements of the Conemaugh series, either partial or complete, are given in the general sections for Albright, Clifton Mills, Gladesville, Newburg, Rockville, 2 miles southwest, Threefork Creek and Trowbridge.

LOCAL SECTIONS

The following section was made by Hennen with aneroid, descending a hill road, 1.2 miles west of Browns Mills in Valley district. Since it was made along a structural slope where the strata are not level, the intervals are greater than true vertical measurement would show:

Browns Mills Section, Conemaugh Series.

	Thickness Feet.	Total Feet.
Sandstone, massive, grayish white and pebbly, Buffalo	..	..
Concealed	10	10
Shale, black, Brush Creek.....	4	14
Coal, Brush Creek (6") (Elevation, 1860' B-A. T.).....	1	15
Fire clay and concealed.....	30	45
Sandstone and sandy shale.....	25	70
Concealed with reds.....	10	80
Concealed	10	90
Fire clay, flinty.....	5	95
Concealed	5	100
Shale, gray.....	5	105
Fire clay, flinty, reddish..15' } Thornton....	20	125
Fire clay, plastic..... 5 }		
Sandstone, massive, Mahoning.....	10	135
Concealed	5	140
Coal blossom, Upper Freeport, (Elevation, 1725' B-A. T.)		

The following section made by Hennen in a deep cut along the Baltimore and Ohio railroad, immediately west of Austen, Lyon district, shows clearly the succession of the lower members of the Conemaugh series for that locality:

Austen Section, Conemaugh Series.

	Thickness Feet.	Total Feet.
Sandstone, massive, greenish gray, Buffalo..	20	20
Shale, dark, Brush Creek.....	25	45
Coal, Brush Creek.....6" to	1	46
Fire clay, plastic.....	20	66
Limestone, nodular, shaly.....1' to	4	70
Fire clay, flinty and plastic, Thornton.....	12	82
Sandstone, greenish gray, medium coarse. micaceous, Mahoning.....	40	122
Coal with partings, Upper Freeport.....		

The following section was measured with aneroid by Reger descending a hill road, one-half mile northeast of Evansville in Reno district:

Section Northeast of Evansville, Conemaugh Series.

	Thickness Feet.	Total Feet.
Concealed from hilltop.....	25	25
Sandstone, flaggy.....25	} Connellsville	74.5
Fire clay shale..... 5		
Sandstone, concealed and sandstone.....19.5		
Coal, 6", Little Clarksburg.....	0.5	75
Shale, brown.....	10	85
Sandstone, flaggy, Morgantown.....	15	100
Concealed	60	160
Coal, Elk Lick, streak (Elevation, 1570' B-A. T.)	0	160
Shale and concealed.....	100	260
Sandstone, brown, Grafton.....	15	275
Shale, greenish yellow, fossiliferous, Ames..	10	285
Shale, dark, streak, Harlem coal (Elevation, 1445' B-A. T.).....	0	285
Shale, yellow, Pittsburgh reds.....	40	325
Sandstone, massive.....	10	335
Shale	40	375
Sandstone, shaly, Saltsburg.....	10	385
Coal, Bakerstown (Elevation, 1345' B-A. T.)..	2	387

The following section was made by Hennen with aneroid, descending a hill road immediately south of Evansville in Reno district. Intervals in the section are in excess of true vertical measurement, owing to the dip:

Section South of Evansville, Conemaugh Series.

	Thickness Feet.	Total Feet.
Shale, red.....	20	20
Sandstone, green, flaggy.....	7	27
Shale	5	32
Concealed	6	38
Coal opening, fallen shut, Elk Lick (Eleva- tion, 1515' B-A. T.).....	2	40
Concealed	50	90
Sandstone, buff, medium coarse.....	20	110
Concealed	35	145
Shale	5	150
Sandstone, broken, Grafton.....	30	180
Shale, dark fossil shells, Ames (Elevation, 1365' B-A. T.).....	5	185
Concealed to road fork (U. S. G. S., 1333')..	37	222

The following section was made by Hennen with aneroid

descending a hill road about one-half mile northwest of Fellowsville, Reno district:

Fellowsville Section, Conemaugh Series.

	Thickness Feet.	Total Feet.
Concealed and shale, gray.....	7	7
Coal, bony..0' 3" } Elk Lick (Elevation,		
Coal, good..2 5 } 1640' B-A. T.).....	2.7	9.7
Concealed	20.3	30
Shale, sandy, red.....	10	40
Sandstone, massive, cliff rock, conglomeratic,		
Grafton	35	75
Concealed	15	90
Shale, black, soft, full of marine fossils, with		
nodules of hard, dark gray limestone,		
Ames	13.7	103.7
Coal opening, Harlem (Elevation, 1545' B-A.		
T.) on land of John Runner.....	1.3	105
Concealed and fire clay.....	55	160
Sandstone, massive, Buffalo.....	104	264
Shale	1	265
Shale, coaly, 4".....	0	265
Concealed	10	275
Coal blossom, Brush Creek (Elevation, 1375'		
B-A. T.).....	0	275

In addition to the sections just given, several records of coal tests will be published in Chapter XII that give much additional data for the Conemaugh series.

DESCRIPTION OF THE FORMATIONS.

The Lower Pittsburgh Sandstone.

The **Lower Pittsburgh sandstone** of White¹, belonging at the very top of the Conemaugh series, like the overlying coal, has been eroded almost entirely away in Preston county, and is present only in the summits of the high hills along the Ligonier and Evansville synclines, near Newburg; in Cope-man knob, 2 miles northeast of Kingwood, in the Kingwood Basin; and in a local structural basin on head of Nigger Hollow, 2 miles southeast of Marquess. At the latter place, Reger reports it capping a high knob where it is soft, gray and 20 feet thick.

¹I. C. White, Vol. II, W. Va. Geol. Survey, p. 244; 1903.

The **Upper Pittsburgh limestone** of White², belonging immediately over the Little Pittsburgh coal, was not observed at any point in the county.

The Little Pittsburgh Coal.

The Little Pittsburgh coal of White³, belonging 40 to 50 feet below the Pittsburgh bed, is confined to the summits of high knobs in the same regions of Preston as that outlined for the Lower Pittsburgh sandstone. The following section was measured at its crop in the hill road, 1 mile southwest of Newburg:

	Ft.	In.
Sandstone, massive, brown, Lower Pittsburgh	10	0
Shale, gray.....	0	2
Coal, Little Pittsburgh (1615' B-A. T.).....	0	10
Fire clay.....		

The coal is too thin and irregular to have any economic importance in the county, unless, as has been suggested on preceding pages, it has thickened up and forms a part of what is generally known as the Pittsburgh vein in Copeman Knob northeast of Kingwood, and in the Fairfax knob in the extreme southeastern point of Preston.

The **Lower Pittsburgh limestone** of White⁴, belonging immediately under the last coal described, was not observed in the county.

The Connellsville Sandstone.

The Connellsville sandstone of J. J. Stevenson, belonging 75 to 100 feet below the top of the Conemaugh series, crops in the summits of the hills along and near the axes of the Ligonier, Evansville and Kingwood synclines; in the vicinity of Newburg in the two first mentioned Basins, and in the region of Albright in the latter. Hennen reports it 30 feet thick,

^{2 3} I. C. White, Vol. II, W. Va. Geol. Survey, p. 245; 1903

coarse, brown, and massive, with streaks of iron, at its crop along the road on the extreme head of Little Raccoon run, $2\frac{1}{2}$ miles southeast of Newburg. Westward from this region it crops in bold cliffs near the summit of the ridge immediately northwest of Maple run where it should make a fair quality of building stone.

It should crop in the West Virginia portion of Fairfax knob in the extreme southeastern point of the county.

The Little Clarksburg Coal.

The Little Clarksburg coal of White⁵, belonging from 0 to 10 feet below the last sandstone described, crops to the surface near the summits of the hills in the same portions of the county as that outlined for the latter formation. It is usually a thin—10 to 18 inches—double-bedded and very persistent coal, but of no present economic value. The sections for Albright and Evansville exhibit its thickness and relative position in the rock column. Its crop is exposed on the northwest side of Copeman knob, Kingwood district, about 140 feet below the Pittsburgh bed, where it is about 15 inches thick.

The **Clarksburg fire clay shale** of Hennen⁶, belonging immediately below the last coal described, does not attain sufficient development and purity in Preston to be considered an economic asset.

The **Lower Connellsville sandstone** of Hennen⁷ and the **Clarksburg limestone** of White⁸, belonging a few feet below the Clarksburg coal, were not observed. The latter formation, however, is probably present in the southwestern part of the county, but concealed by debris.

The **Clarksburg Red Shale** of Hennen⁹ was observed at

⁵I. C. White, Bull. 65, U. S. G. Survey page 88; 1891.

⁶Ray V. Hennen Doddridge-Harrison Rept. W. Va. Geol. Survey, p. 236; 1912.

⁷Ray V. Hennen Monongalia-Marion-Taylor Rept., W. Va. Geol. Survey, p. 277; 1913.

⁸I. C. White, Bull. No. 65, U. S. G. Survey, p. 88; 1891.

⁹Ray V. Hennen, Doddridge-Harrison Rept., W. Va. Geol. Survey, p. 240; 1912.

one or two localities, but it is not of sufficient economic importance in the county to warrant further description.

The Morgantown Sandstone.

The Morgantown sandstone of J. J. Stevenson, belonging at about 200 feet below the Pittsburgh coal and 40 to 50 feet below the Clarksburg limestone, attains fair development where its crop is exposed along the axes of the Ligonier, Evansville and Kingwood synclines in the vicinity of Newburg, Evansville and Albright. It is generally a coarse, massive, micaceous and arenaceous stratum, ranging in thickness from 20 to 40 feet. Its position in the rock column is exhibited in the general section of the Conemaugh series and that for Evansville. It is the sandstone that forms the great cliffs just above the bed of Greens run at Greens Run Station, 1 mile southwest of Albright, where the following section was measured by Hennen:

	Ft.	In.
Sandstone, massive, gray and brown, medium grained, Morgantown.....	50	0
Shale, gray 3" to	5	0
Coal, slaty, Elk Lick (1450' B-A. T.).....	0	3
Fire clay shale to railroad grade.....	3	0

Three and a half miles southwestward this stratum crops in the public road at an elevation of 1915' B-A. T., 0.7 mile east of Ironton, where it is massive, buff-colored and 25 feet thick.

Although quite extensively used as a building stone in Monongalia county, this sandstone does not give very good satisfaction in exposed structures, owing to its tendency to weather badly. However, in the Kingwood Basin it appears to be more firmly cemented and should make a fair building rock.

The Elk Lick Coal.

The Elk Lick coal belongs from a few inches to 10 feet below the last sandstone described and about 250 feet below the Pittsburgh vein. It is a fairly persistent bed, ranging in thickness from 0 to 4 feet, and has been mined quite extensive-

ly by the farmers of Preston for domestic fuel southeastward from Newburg and southward from Marquess. Only a small portion of its original area is left uneroded in the county, its crop being confined to the hills in that part of the Ligonier Basin south of Browns Mills; to the hills along and near the axis of the Evansville Basin southward from Newburg; to the local synclinal basin westward from Sinclair; to that part of the Kingwood Basin southward from near the mouth of Muddy creek to near the mouth of Pringle run of Cheat river; and to a very small triangular area—one-third square mile—in the extreme southeastern point of the county. Its thickness and relative position in the rock column are exhibited in the sections for Newburg, Evansville and Fellowsville.

Along the east border of Lyon district, Reger obtained the following section at the crop of this coal just west of the cross-roads, 1.3 miles north of Hiorra:

	Ft.	In.
Shale	..	..
Coal, Elk Lick (1730' L-A. T.)	1	9
Shale, with nodules of limestone (Elk Lick)	15	0
Shale, brown.....	..	..

This coal was once opened along the southeast edge of the same district at an elevation of 1640' A. T. aneroid on the head of Little Raccoon run, but no section was obtained at this mine.

Westward in the same district it is reported about 4 feet thick at an old opening in the hill immediately south of Newburg.

In Reno district it has been mined quite a good deal by farmers along the flanks of the Evansville syncline, especially on the head of York run. The following section was measured by Hennen at an opening on the east edge of the hill road, 0.6 mile north of Fellowsville, 95 feet by aneroid above another opening in the Harlem bed:

Mine No. 4 on Map II, Elk Lick Coal.

	Ft.	In.
Slate, gray.....	..	..
Coal, bony..0' 3" } Elk Lick.....	2	8
Coal, good..2 5 } (1640' B-A. T.)		

The composition of a sample collected from the lower bench, as reported by Messrs. Hite and Krak, is found under No. 4 in the table of coal analyses at the end of Chapter XII.

Two to three miles southwestward, Hennen measured the following section at its crop along the road at an elevation of 1495' A. T. aneroid, 1 mile southwest of Evansville, where it attains the best development observed in the county:

		Ft.	In.
Shale, dark.....			
Coal, slaty.....1' 6"	} Elk Lick.....	6	10
Coal, bony.....0 6			
Coal, soft.....1 6			
Coal, bony.....0 4			
Slate, with streaks of coal.....0 3			
Coal, bony.....0 6			
Coal, soft.....2 3			
Fire clay and concealed.....		15	0
Limestone, nodular and brecciated, Elk Lick		2	0

This bed is the cannel coal seam that is mined along the east hillside of Sandy creek along the Preston-Barbour county line, 1.8 miles southwest of Sinclair, where Hennen obtained the following section on the land of Jas. Lindsey:

		Ft.	In.
Slate			
Coal, hard.....0' 8½"	} Elk Lick.....	3	4
Coal, softer.....2 7½			
Slate	(1570' B-A. T.)	..	..

The crop of this coal was observed at several points in Kingwood Basin, Kingwood district. It is 18 inches thick at its crop in the road, ½ mile south of Kingwood, coming at an elevation of 1785' A. T. aneroid.

Northeastward at Greens run it is not so thick as shown by the following section measured 0.1 mile northeast of Greens Run Station:

	Ft.	In.
Sandstone, Morgantown.....	100	0
Coal, slaty, Elk Lick (1450' B-A. T.).....	0	5
Limy conglomerate, hard, Elk Lick Limestone in bed Greens run.....	5	0

The following section was obtained by Hennen along the

west hillside of Cheat river at the crop of this coal, $\frac{1}{2}$ mile west of Caddell:

	Ft.	In.
Sandstone, shaly, Morgantown.....	20	0
Coal, Elk Lick (1485' B-A. T.).....	0	11
Fire clay shale.....	9	0
Limestone, gray and hard, Elk Lick.....	4	0
Unrecorded	95	0
Coal, Harlem		

Crossing Cheat river into Portland district, the following section was obtained by Reger at an opening in this bed, 1 mile southeast of Trowbridge Ferry and railroad bridge:

Felix T. Jeffers Opening, Mine No. 3 on Map II.

	Ft.	In.
1. Slate, black.....	..	..
2. Coal, bony.....0' 5 "	Elk Lick coal 2 (1845' B-A. T.)	10
3. Coal, medium hard, good 1 0		
4. Slate, black.....0 0½		
5. Coal, medium hard, good 1 4½		
6. Fire clay.....	..	..

The composition of the sample for analysis from Nos. 3 and 5 only of section, as reported by Messrs. Hite and Krak, is found under No. 3 in the table of coal analyses at the end of Chapter XII.

The chemical composition, character and available minable area of the Elk Lick coal will be discussed on subsequent pages in the last mentioned chapter.

The Elk Lick Limestone.

The Elk Lick limestone of Messrs. Pratt¹⁰, belonging 0 + 10 feet below the last coal described, was observed at crop at several points in the Ligonier, Evansville and Kingwood Basins. The sections above under the description of the Elk Lick coal exhibit its thickness and character. It apparently attains its best development in the Kingwood Basin as is shown by the section above for the coal of the same name, 0.5

¹⁰Report HHH, Second Geol. Survey of Penna.

mile west of Caddell, where it is 4 feet thick and apparently quite pure. A sample for analysis was collected at this point, the composition of which as reported by Messrs. Hite and Krak, is found on a subsequent page under "Limestones". The ledge is too thin and irregular to have much economic importance.

The **West Milford coal** of Hennen¹¹, belonging immediately below the last limestone described, was not observed, although its horizon was exposed at several points.

The **Birmingham shale** of Stevenson¹², as in Monongalia, Marion and Taylor counties, has been largely replaced by the Grafton sandstone.

The Grafton Sandstone.

The Grafton sandstone of White¹³, belonging 1 to 20 feet below the Elk Lick limestone and 10' to 20 feet above the Harlem coal, attains a fine development in Preston county. Here it is a massive, pebbly, coarse and arenaceous stratum, ranging in thickness from 20 to 40 feet, its crop being largely confined to the Ligonier Basin southward from Cheat river; the Evansville Basin; the Kingwood Basin southward from Hayden to the mouth of Pringle run of Cheat river; and the small local Basin immediately west of Sinclair. It should crop in the hill slope immediately north of the Fairfax Stone at the extreme southeastern point of the county. Wherever it comes to the surface it plays a conspicuous part in the topography, in that it forms steep slopes and escarpments around the hillsides. Its thickness and relative position in the rock column are exhibited in the sections for Gladesville, Newburg, Albright, Evansville and Fellowsville.

It is this sandstone that caps the high knob and strews the ground with large boulders one-fourth mile northeast of the common corner to Preston, Monongalia and Taylor counties. At Newburg and Albright it crops about one-third way up the hillsides where a good thickness is exposed, especially at the

¹¹Ray V. Hennen; Doddridge-Harrison Rept., W. Va. Geol. Survey, p. 246; 1912.

¹²J. J. Stevenson, Rept. K, Sec. Geol. Sur. of Penna., pp. 79, 309-310.

¹³I. C. White, Vol. II, W. Va. Geol. Survey, p. 255; 1903.

latter point where it would make an excellent quality of building stone. Near the central portion of Reno district it is also a prominent cliff former half way up the south hillside of Right fork, $\frac{3}{4}$ mile southwest of "Pleasant Valley Church". No quarries were observed on this ledge in the county.

The Ames Limestones and Shale.

At 5 to 10 feet below the Grafton sandstone and slightly below the middle of the Conemaugh series occurs a calcareous and very fossiliferous formation known as the **Ames limestone**. It is the first well-marked marine stratum in descending order in the Carboniferous rocks of the Appalachian basin, and often occurs in two layers, each 1 to 5 feet thick, separated by 10 to 20 feet of dark green shale with many species of marine fossils; the top limestone being known as the **Upper Ames**; the bottom, the **Lower Ames**; and the included fossiliferous formation, the **Ames shale**¹⁴. Each of the limestones carries marine fossils in profusion, but in this county both are generally replaced by the intervening shale. The thickness and relative position of the formation in the rock column are exhibited in the sections for Threefork, Newburg, Albright, Trowbridge, Evansville, Evansville S. and Fellowsville, its crop being confined to the same regions of the county as that outlined for the Grafton sandstone.

In Grant district Reger reports the fossiliferous Ames shale in the summit of a high knob just west of the axis of the Ligonier Basin, 1 mile northwest of Hopewell Church, at an elevation of 1995' B-A. T. This knob apparently holds the only area of the formation in Grant district that is left uneroded.

Southwestward along the same Basin in Valley district the crop of the shale is exposed at the north edge of the road about 200 yards eastward from the crossroads at Reedsville, at an elevation of 1818' L-A. T.; and also in the southern point of the same district along the road, 0.3 mile southeast of Browns Mills, at an elevation of 1730' A. T., aneroid, where 15

¹⁴Ray V. Hennen, Doddridge-Harrison Rept., W. Va. Geol. Survey, p. 250; 1912.

feet of black shale with marine fossils directly overlies 18 inches of Harlem coal. Neither of the two limestones appears to be represented there.

Along the northeast border of Lyon district Hennen reports 15 feet of black fossiliferous shale at this horizon near the residence of J. C. Bucklew, 0.4 mile northeast of the mouth of Martins run, at an elevation of 1515' A. T., aneroid. Passing to the southwest edge of the same district the following section is reported by Hennen at this horizon along the north edge of the road on Maple run, one-fourth mile northeast of the latter's intersection with the Preston-Taylor county line, at an elevation of 1435' A. T., aneroid:

	Ft.	In.
Shale, dark, marine shells, Ames.....	12	0
Limestone, brecciated and nodular, marine shells, Lower Ames.....	3	0
Concealed	..	..

In the extreme southern point of Lyon district, Reger reports the following section on the north hillside of Little Sandy creek:

	Ft.	In.
Shale green, Ames, visible.....	5	0
Limestone, hard, Lower Ames.....	1	0
Coal, Harlem.....	..	..

In the northeast portion of Kingwood district the Ames shale is very persistent. The following section was measured by Hennen at its crop along the M. & K. R. R. grade, 1 mile northeast of Kingwood station:

	Ft.	In.
Shale, sandy, buff.....	15	0
Shale, dark.....	10	0
Shale, dark, with limestone nodules, marine fossils, Ames.....	4	0
Coal, Harlem (1565' B-A. T.).....	1	7½
Fire clay shale to railroad grade.....	5	0

A collection of specimens of marine fossils was made at this point by Dr. J. W. Beede of the University of Indiana, whose report on the same, as published on pages 293-294 of the Monongalia-Marion-Taylor Report of the W. Va. Geol. Survey, is as follows:

Preston County, 1 Mile NE of Kingwood, M. & K. R. R. Cut.

Ames Shale:

Aclisina? sp.
Aclisina swallowana.
Ambocoelia planoconvexa, a.
Astartella gurleyi, c.
Astartella vera, r.
Aviculopecten sp., r.
Bulimorpha chrysalis.
Bellerophon percarinatus.
Bellerophon stevensanus? r.
Bulimorpha sp.
Bulimorpha? sp.
Chonetes granulifer, c.
Chonetes variolatus.
 Crinoid fragments.
Derbya crassa, c.
Edmondia aspenwallensis?
Endothyra? sp., r.
Euomphalus catilloides.
Euphemus carbonarius, c.
Leda attenuata, c.
Loxonema rugosum, r.
Loxonema semicostatum, r.
Loxonema scitulum, r.
Nucula parva, a.
Orthoceras rushensis.
Orthonema quadricarinatum.
Orthonema? sp.
Orthonema Cf. subtaeniatum, r.
Patellostium montfortianum,
Pelecypod. Cf. *Allorisma* geinitzi.
Pelecypod. Two species.
Pleurophorus Cf. obsoletus.
Pleutomaria Cf. brazoensis.
Productus cora? r.
Serpula? sp., r.
Sphaerodoma primigenia?
Soleniscus brevis.
Soleniscus paludinaeformis?
Tainoceras occidentalis? r.
Worthenia Cf. speciosa, a.

Ten feet of the shale, black and very fossiliferous, is exposed along the M. & K. R. R. grade, about 300 yards west of the tunnel, 0.6 mile northwest of Albright, at an elevation of 1415' A. T. aneroid, directly over the Harlem coal.

Along the western edge of the same district 30 feet of black and fossiliferous shale, with no limestone, crops at this horizon, one-fourth mile northeast of Morris Park station on the M. & K. R. R., at an elevation of 1430' A. T., aneroid, di-

rectly below the Grafton sandstone and over 2 feet of Harlem coal.

Passing southwestward to Reno district in the region southwest of Fellowsville, the following section is reported by Reger along the road, 0.1 mile south of Israel Church:

	Ft.	In.
Sandstone, massive, very pebbly, Grafton...	15	0
Concealed	25	0
Shale, greenish yellow, fossiliferous Ames..	10	0
Coal, Harlem (1640' L-A. T.).....	1	0

The Ames limestones are too thin and irregular to have any economic value, but they are of great scientific interest for reasons heretofore given. For a discussion of the fossil fauna of the limestones and shale in northern West Virginia, the reader is referred to pages 291-296 of the Monongalia-Marion-Taylor Report of the State Survey, and Appendix "B" of this report.

The Harlem Coal.

From a few inches to 10 feet below the last formation described there occurs a thin—6 to 24 inches—and very persistent coal known as the **Harlem**. The names "Crinoidal" and "Friendsville" have been applied to the same vein by the Pennsylvania and Maryland Surveys, respectively, but the first mentioned holds by right of priority.

Its crop in Preston is confined to the same regions of the county as that outlined for the Grafton sandstone. Its thickness and relative position in the rock column are exhibited in the sections for Threefork, Newburg, Albright, Trowbridge, Evansville and Fellowsville. In the regions of its crop the approximate position of the bed can be readily ascertained by adding 300 feet to the elevation of the top of the Upper Freeport bed as shown by green structure contour lines on Map II.

In Grant district an attempt was made to open this coal near the summit of a high knob just west of the axis of the Ligonier Basin, 1 mile northwest of Hopewell Church, at an elevation of 1995' A. T., aneroid, according to Reger. This knob apparently holds the only remaining area of this bed in the district that has escaped erosion.

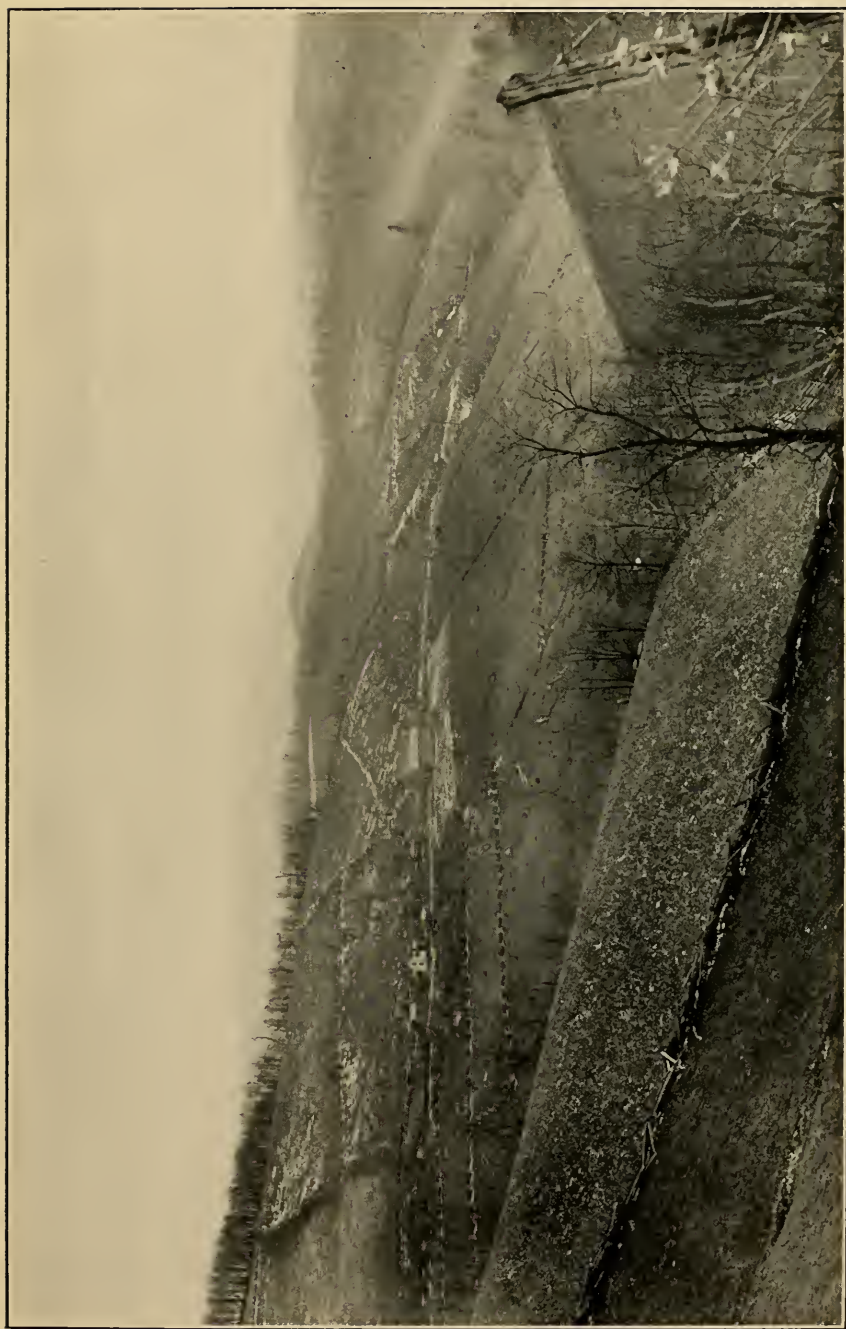


Photo by E. E. Knight
PLATE IX.—Showing uniform slopes in topography of the Chemung Series, looking south down Horseshoe Run from point 1.8 miles southwest of Eglon.

Southwestward along the same Basin in Valley district, this coal crops in the north edge of the road, about 200 yards eastward from the crossroads in the old part of the town of Reedsville, at an elevation of 1817' A. T., spirit level, where a thickness of 12 inches is visible.

In the southern point of the same district, it is 18 inches thick at its crop immediately below 15 feet of black and fossiliferous Ames shale, 0.3 mile southeast of Browns Mills. Near this point the same coal crops 16 feet by hand-level, according to Reger, above the top of the Wm. Brown Heirs core test boring (60).

Southwestward in Lyon district this coal attains a fair development and is mined locally by farmers for domestic fuel. The following section was measured by Hennen at the J. C. Bucklew mine in the northeast portion of the district, 0.4 mile northeast of the mouth of Martins run:

	Ft.	In.
Shale, black, marine fossils, Ames.....	15	0
Coal, Harlem, (1575' B-A. T.).....	1	6
Shale, dark.....		

One mile and a half south 80 degrees westward this vein has been opened on the land of Cordelia A. Lanham, where the following section was measured by Hennen:

	Ft.	In.
Concealed from top of knob.....	..	..
Shale, dark, with gastropods and chonetes fossils, Ames.....	10	0
Coal, blocky, Harlem (1835' B-A. T.).....	1	6
Fire clay and concealed.....	8	6
Limestone, nodular, gray, Ewing.....	1	6
Concealed	75	0
Slate, gray and yellow.....	7	0
Slate, black, bituminous.....	3	0
Limestone, Pine Creek (Albright).....	2	6

The coal gives excellent results as domestic fuel. An attempt was made to burn the limestone at the base of the section for fertilizing purposes, but it contained too many impurities to burn up into ashes, according to Mr. Lanham.

Eastward in Kingwood district this bed is brought down into the hills in Kingwood Basin, and along the west edge of the public highway between Kingwood and Tunnelton, 1.5

miles south of Irona, where it is 20 inches thick at its crop immediately below the fossiliferous Ames shale.

The following section was measured at a mine in this coal on the west edge of the public road, 0.3 mile south of Albright:

Allison Snider Mine, Harlem Coal.—No. 6 on Map II.

	Ft.	In.
Shale, dark, marine shells, Ames.....	10	0
Coal, good.....2' 0" } Harlem	2	3
Coal, slaty.....0 3 } (1375' B-A. T.)		
Fire clay.....	..	..

This is the thickest section of the coal observed in the county. A sample for analysis was collected from the upper bench, the composition and calorific value of which, as reported by Messrs. Hite and Krak, are found under No. 6 in the table of coal analyses at the end of Chapter XII.

The following section was measured at the crop of the Harlem coal along the east edge of the same district, 0.3 mile northeast of Morris Park station on the M. & K. R. R.:

	Ft.	In.
Sandstone, flaggy, Grafton.....	25	0
Shale, black, with marine shells, Ames.....	30	0
Coal, Harlem.....	2	0
Fire clay shale.....	4	0
Limestone, nodular and shaly, brecciated, Ewing	6	0

The northwest edge of Portland district catches a few acres of this bed in the Kingwood Basin that has escaped erosion. The following section was measured by Reger at a mine along the east hillside of Muddy creek, 1.5 miles southwest of Hayden:

Wm. G. Brown, Jr., Mine, Harlem Coal—No. 5 on Map II.

	Ft.	In.
Shale, dark.....	3	0
Limestone, hard, very fossiliferous, gastropods, etc., Lower Ames.....	2	0
Coal, good, Harlem.....	1	10
Slate, black	0	2
Fire clay.....	..	..
(Elevation of coal, 1650' A. T. aneroid).		

A sample of the coal for analysis was collected here, the composition and calorific value of which are found under No. 5 in the table of coal analyses at the end of Chapter XII.

Southwestward in Reno district, this vein is only 2 inches thick at its crop at the road fork, 0.6 mile northeast of Dent, at an elevation of 1500' A. T., aneroid, coming there immediately at the base of 5 feet of green, fossiliferous Ames shale.

It is only 8 inches thick at its crop along the hill road in the southwest edge of the same district, 0.7 mile north of Colebank, coming there at an elevation of 1500' A. T., aneroid, according to Hennen; and only 4 inches thick, 0.8 mile southward at its crop in the road, at an elevation of 1805' A. T., aneroid, according to Reger.

Three miles northwestward Reger reports only 2 inches visible at its crop in the road at Mt. Zion Church, at an elevation of 1560' A. T., aneroid, immediately below the fossiliferous Ames shale and above 40 feet of Pittsburg reds.

This bed should furnish quite a large tonnage of fair coal when the thicker and better veins of the same region approach exhaustion. The character and probable available area of this bed will be discussed on subsequent pages in the chapter on Coal.

The Ewing Limestone.

The Ewing limestone, belonging 1 to 10 feet below the last coal described, has assumed a more or less nodular and brecciated form in Preston, and ranges in thickness from 1 to 6 feet. The sections given above under the description of the Harlem coal at the Cordelia Lanham mine and at the exposure $\frac{1}{4}$ mile northeast of Morris Park station, exhibit its thickness, character and relative position in the rock column. It is this limestone that crops in the edge of the hill road, $\frac{3}{4}$ mile south 45° east of Pleasant Valley Church, 3 miles eastward from Fellowsville, at an elevation of 2065' A. T., aneroid, where it is 2 feet thick, nodular and brecciated, directly overlying the dark red Pittsburg shale. This formation is too thin, irregular and impure to have much economic value, except to add to the fertility of the soil in the immediate region of its crop.

The Pittsburgh Red Shale.

Immediately underlying the last formation described belongs the Pittsburgh red shale of White¹⁶, which ranges in thickness from 30 to 100 feet in this county. It is a soft, purplish red shale, containing nuggets of impure limestone and iron ore, and it affects the topography in a marked manner wherever it crops around the hillsides, in that gentle slopes or prominent benches are formed, the soil on the same being quite fertile. Hence, these benches are generally the first to be cleared out and cultivated. I. C. White gives an interesting account of these shales in the State on pages 263-265 of Vol. II of the State Geological reports. Their thickness and relative position in the rock column are exhibited in the sections for Gladesville, Threefork and Evansville.

The Saltsburg Sandstone.

The Saltsburg sandstone, belonging 40 to 60 feet below the Harlem coal and ranging in thickness from 25 to 50 feet, has a fine development in the county. Its crop follows practically the same region as that outlined on Map II for the Bakerstown coal, since it generally overlies the latter bed from a few inches to 10 feet. Its thickness and relative position in the rock column are exhibited in the sections for Rockville, Gladesville, Newburg, Albright, Trowbridge and Evansville. One of the largest and most up-to-date building stone quarries in the State is located on this ledge at Knowlton, 1 mile north of Kingwood, a full discussion of which will be given under "Building Stones" in a subsequent chapter. Here it is yellowish in color, mottled with specks of iron oxide, and ranges in thickness from 20 to 25 feet, the base of the same resting on clay. At Albright, 2 miles eastward, it crops in a bold cliff, 20 to 25 feet high, along the M. & K. R. R. grade, where it is bluish gray and grayish brown in color, mottled with specks of iron oxide as at Knowlton, a feature characteristic of the ledge wherever exposed in the county and much resembling the Lower Connellsville sandstone¹⁷ at Morgantown, Monongalia county.

¹⁶I. C. White. Bull. No. 65, U. S. G. Survey, p. 92; 1891.

¹⁷Monongalia-Marion-Taylor Rept., W. Va. Geol. Survey, pp. 277-278.

The old Gocella quarry, located 0.4 mile southeastward, described on page 483 of Vol. IV of the State Geol. Reports, belongs in this ledge. In Pleasant district it is this stratum that caps the knobs and strews the ground with large boulders on the east hillside of Big Sandy creek, 1 to 2 miles southwest of Rockville. In the southern point of the same district the ridge road leading southeast from the head of Martins run to a point 0.3 mile north of the mouth of Muddy creek, is mostly in and on this stratum, the latter having prevented the ridge from much more complete erosion.

Northeastward in the same district this ledge caps the high knob located one-fourth mile northeast of Lenox. Southward in Kingwood district it forms the prominent cliffs along the ridge road immediately south of Lick run, 1 mile eastward from Camp Chapel, and likewise along the road, 1 mile southeast of Pleasant Valley Church and 3 miles east of Fellowsville.

The Bakerstown Coal.

The Bakerstown coal¹⁸, belonging 75 to 100 feet below the Ames limestones, attains sufficient development in Preston to be classed as a commercial bed. It is referred to as the "Barton" vein in Maryland. Its crop is outlined in detail by an appropriate symbol on Map II. Its thickness and relative position in the rock column are exhibited in the sections for Rockville, Newburg, Albright, Trowbridge and Evansville. At present there are no commercial mines in this coal in the county, but it has been mined for domestic fuel by farmers in every district except Union.

In **Grant district** this coal was once mined by stripping on the summit of the high knob on the land of T. S. Benson, 0.8 mile south of Laurel Church, at an elevation of 1860' A. T., aneroid, 30 feet above 18 inches of very fossiliferous Pine Creek limestone. Mr. Benson reports the coal as 4 feet thick and covered with only 4 to 5 feet of soil.

Northeastward in the same district it is mined near the summit of the high knob, 0.9 mile north 80° west of Bruceton, on the land of Ira Thomas, at an elevation of 1905' A. T., aneroid, where it is reported 4 feet thick.

¹⁸I. C. White, Rept. Q, Second Geological Survey of Penna.

In **Pleasant district** this coal was once opened on Raymond Bishop's farm, 2 miles west of Morgans Glade, at an elevation of 2000' A. T., aneroid, where the following section was measured and published on page 608 of Vol. 11(A) of the State Geological reports:

	Ft.	In.
Shale and concealed.....	..	..
Coal, bony.....1' 0" }	4	6
Coal, good.....3 6 }		
Fire clay.....	..	..

In the same district the following section was measured at the Howard Martin mine in this bed near head of Martins run, 0.8 mile southwest of Mine No. 26 on Map 11:

	Ft.	In.
Slate, black	4	0
Coal, bony.....0' 5" }	2	10
Coal, slaty.....0 4 }		
Coal, good.....2 1 }		
Slate	..	..

On the eastern slope of the Kingwood Basin in the same district, Reger obtained the following section at a mine in the bed on the north side of Kelley Knob:

	Ft.	In.
Sandstone, massive, Saltsburg.....	..	..
Shale	10	0
Slate, black.....	2	0
Coal, hard, bony....0' 5" }	2	4
Coal, soft.....1 11 }		
Shale, gray and soft.....	..	..

In **Valley district** the Bakerstown coal attains its best development in the county and many openings occur therein along its crop. Reger reports it 40 inches thick at the Ashburn mine, 0.6 mile east of Burk, at an elevation of 1725' A. T., aneroid.

The following section was measured by Hennen at the Burgess McMillen mine, 0.3 mile north of Reedsville:

	Ft.	In.
Shale, dark gray.....	..	..
Coal, bony.....0' 7" }	3	10
Coal, softer, good...3 3 }		
Fire clay.....	..	..
(Elevation of coal, 1730' A. T., aneroid).		

The Bakerstown coal was once mined commercially by the Elkins Coal & Coke Company on the south side of Dillan creek, $1\frac{1}{4}$ miles southeast of Bretz station, but here it was so cut up with "clay veins" that it was abandoned. The composition of a sample from this opening, as reported by Hon. Davis Elkins, President of the company, and published on page 627 of Vol. 11(a) of the State Geological Survey Reports, is as follows:

	Per cent.
Moisture	1.10
Volatile Matter.....	28.54
Fixed Carbon	63.71
Ash	4.80
Sulphur	1.84
	99.99

The sulphur has been inadvertently included in the total.

Reger obtained the following section at the Ed M. Heermans mine in this bed, located on the south side of the Kingwood pike, $1\frac{1}{4}$ miles east of Reedsville:

		Ft.	In.
Shale, brown.....		4	0
Slate, black.....		0	2
Coal 0' 2"	} Bakerstown ... (Elev., 2010' A. T., aneroid).	5	6
Slate, black.....0 1			
Coal 0 1			
Slate, black.....0 6			
Coal 0 3			
Slate, black.....0 8			
Coal, good.....3 9			
Shale, gray.....		..	..

Passing to the eastern edge of the same district the following section was obtained by Hennen at the Edward Brown bank, 2 miles S. 20° E. of Reedsville:

		Ft.	In.
Shale, gray.....		1	0
Coal, bony...0' 7"	} 2' 1 " } Bakerstown coal (Elev., 1900' A. T. aneroid).	5	7½
Coal, soft...0 4			
Coal, bony...0 1			
Coal, soft...0 6			
Coal, bony...0 7			
Coal, soft.....3 6½			

The top portion of this bed is generally bony and impure, the same attaining at this mine the unusual thickness of 25 inches.

In **Lyon district** this coal is opened frequently by farmers with small drift mines. The following section was obtained by Reger on the waters of Lick run on the south side of the east and west road, 1.5 miles west of Oriole:

	Ft.	In.
Concealed	..	..
Coal, good, Bakerstown (1525' B-A. T.).....	2	6
Shale, gray.....	..	..

Southwestward in the same district, Reger measured the following section at a mine in this coal, 1 mile north of Hiorra:

John Crogan Mine, Bakerstown Coal—No. 11 on Map II.

	Ft.	In.
Shale	..	..
Coal, bony.....1' 6" } Bakerstown ...	4	6
Coal, good.....3 0 } (Elev., 1535' B-A. T.)		
Shale, hard.....	..	..

A sample for analysis was collected here from the lower bench, the composition and calorific value of which are found under No. 11 in the table of coal analyses at the end of Chapter XII.

Westward in **Lyon district** this vein has been opened on the J. W. Lee farm on the south side of the B. & O. R. R., 1 mile northeast of Newburg, at an elevation of 1350' A. T., aneroid, where a thickness of only 18 inches is reported.

It is 36 inches thick at its crop in the road bend, 0.5 mile west of Independence, coming there at an elevation of 1325' A. T., aneroid.

In **Kingwood district** the Bakerstown bed has long been mined southwest of the town for a domestic fuel supply; and at Albright it was once mined for the same purpose before the construction of the M. & K. R. R. in the ravine just under the railroad bridge a few hundred feet westward from Albright Station, where Mr. A. J. Snider of the latter place reports the following section:

	Ft.	In.
Coal, bony.....0' 3" }		
Coal, slaty.....0 3 }		
Coal, hard, good....3 0 }		
Slate pavement.....	..	..
	3	6

A short distance west of Snyder and 1 mile southwest of Kingwood, Hennen collected samples for analysis and measured the following section at 2 mines in this bed:

J. Craig and Eli Moore Mines—Bakerstown Coal.
Nos. 8 and 9 on Map II.

(No. 8)		(No. 9)	
Slate		Slate	
Coal	0' 3" } 3' 2"	Coal, bony.....	0' 3" } 3' 4"
Coal, good.....	2 11 }	Coal, soft, good.	3 1 }

The composition and calorific value of the samples from the bottom benches are found under Nos. 8 and 9, respectively, in the table of coal analyses at the end of Chapter XII.

Reger collected a sample for analysis and measured the following section at a Bakerstown mine, $\frac{1}{2}$ mile east of Irona:

Jas. Craig Mine.—No. 10 on Map II.

	Ft.	In.
Slate, dark.....	..	..
Coal, bony.....	1' 3" } Bakerstown ..	.4. 3
Coal, good.....	3 0 }	(Elev., 1760' B-A. T.)
Shale	..	..

The composition and fuel value of the sample are found under No. 10 in the table of coal analyses mentioned above.

Along the east border of the same district, Hennen measured the following section at the Jas. W. Riley bank, located 1 mile S 60° W of the mouth of Pringle run:

	Ft.	In.
Shale, dark and sandy.....	..	..
Coal, bony.....	1' 5" } Bakerstown	4 5
Coal, good.....	3 0 }	(Elev., 1735' B-A. T.)
Slate pavement.....	..	..

Along the west border of Portland district there occurs a small area of this coal in the Kingwood Basin. Reger measured the following section at the C. S. Chidester bank in this region:

	Ft.	In.
Shale, brown, silicious and ferriferous.....	10	0
Coal, bony.....	0' 9" } Bakerstown	3 6
Coal, good.....	2 9 }	(Elev., 1800' B-A. T.)

In **Reno district** this bed does not appear quite so thick as northward. However, several local farmers' banks are found on its crop. The following section was measured by Reger at a bank 10 feet above the mouth of the W. S. Jenkins boring (89), 0.8 mile northeast of Evansville:

	Ft.	In.
Shale	..	..
Coal, good, Bakerstown	2	6
Shale	10	0
(Elevation of coal 1350' B-A. T.)		

The following was measured at another bank 1.5 miles northeast from Evansville:

	Ft.	In.
Shale, sandy and hard.....	15	0
Coal 0' 5" }		
Shale, gray.....0 8 } Bakerstown	2	8
Coal, good.....1 7 } (Elev., 1410' B-A. T.)		
Shale, gray limy, fossiliferous, Pine Creek		
Limestone	4	0
Shale, ferriferous.....	1	0
Shale, silicious, to creek.....	15	0

In the western edge of the same district there is an old abandoned mine in this bed, 0.2 mile due south of Eby, at an elevation of 1480' A. T., aneroid. It had fallen shut when visited in August, 1912.

In the central portion of Reno it is this coal that has been mined at the north edge of the road, along Tibbs fork, 1.5 miles S 70° E of Fellowsville, at an elevation of 1640' A. T., aneroid. A section was not obtained here owing to the opening having fallen shut. The same was true of another mine in this bed, 0.3 mile eastward from Fellowsville, where it has an elevation of 1510' A. T., aneroid.

It is the Bakerstown coal that has been opened on the head of Tibbs fork, along the private road $\frac{1}{4}$ mile northeast of Union Church, at an elevation of 1805' A. T., aneroid. This mine had also fallen shut, but 3 miles southwestward Reger reports it only 18 inches thick at its crop in the road at an elevation of 1640' A. T., spirit level, one-eighth mile south of Israel Church.

Along the southern edge of Reno district, Reger measured

the following section at the Rosier Heirs mine in this bed on the north side of the road, $\frac{1}{4}$ mile northwest of Colebank:

	Ft.	In.
Sandstone, massive, gray, Saltsburg.....	5	0
Shale, gray silicious.....	1	6
Sandstone, massive, hard.....	0	6
Shale, gray.....	1	0
Coal, hard.....1' 1" } Bakerstown ...	2	1
Coal, soft.....1 0 } (Elev. 1410' B-A. T.)		
Shale	..	..

Here it belongs 90 feet by hand-level below the Harlem coal, as determined by Reger immediately to the southwestward on the Barbour side of Sandy creek. He reports no coal at the horizon of this bed where it is exposed in the road slightly over a mile north of Sinclair, the interval between the Saltsburg and Buffalo sandstones being occupied by shale.

Reger collected samples for analysis and measured the following section at a mine in this vein on Left fork of Sandy, 0.3 mile southwest of Marquess:

C. N. Matlick Mine.—No. 12 on Map II.

	Ft.	In.
1. Shale, green, fossiliferous, Ames.....	..	..
2. Coal, Harlem, visible.....	0	3
3. Interval by aneroid.....	100	0
4. Slate, black.....	0	6
5. Coal, cannel.....1' 3" } Bakerstown ...	2	0
6. Coal, bituminous 0 9 }		
7. Shale, gray.....		
(Elevation of Bakerstown coal, 1465' B-A. T.)		

The composition and fuel value of the samples from Nos. 5 and 6 of the section are found under No. 12 (Lab. No. 763H) and No. 12 (Lab. No. 764H), respectively, in the table of analyses at the end of Chapter XII.

Sufficient data have been given to show that the Bakerstown vein should be taken into consideration when estimating the available fuel resources of Preston county. Its chemical composition, character and probable minable area will be discussed more fully in the last mentioned chapter.

The Albright Limestone.

On the south side of Cheat river at Albright there occurs a dark gray limestone, 2 feet thick, immediately underlying the Bakerstown coal (see Albright section, page 92). It is frequently present in Preston county and apparently belongs 5 to 20 feet above the marine fossiliferous Pine Creek limestone; hence, the writers have designated it the Albright limestone from the latter town. It is too thin and irregular to be considered of much economic importance except to add to the fertility of the soil in the immediate region of its crop.

The Pine Creek Limestone.

The Pine Creek limestone¹⁹, belonging 90 to 120 feet below the Ames limestones, 10 to 30 feet below the Bakerstown coal and closely overlying the Buffalo sandstone, is quite generally present in Preston, its crop being confined to practically the same portions of the county as that outlined for the Bakerstown coal. Like the Ames above and the Brush Creek below, it usually carries many marine fossils, and ranges in thickness from 6 inches to 3 feet.

In Grant and Pleasant districts this ledge appears fairly persistent. In the former its crop is exposed near the summit of a high knob, 1 mile south of Laurel Church, 30 feet below and 200 yards northeast of an old digging on the top of the knob in the Bakerstown coal, the latter being mentioned on a preceding page. Here, the limestone is 18 inches thick, at an elevation of 1830' A. T., aneroid, carrying many fossil brachiopods, crinoids, corals, etc. T. E. Benson attempted burning it from this point into agricultural lime with no success owing to an excess of silica and other impurities.

In the eastern half of the same district its crop is exposed on the north side of the road, $1\frac{1}{4}$ miles S 70° E of Bruceton Mills, at an elevation of 1920' A. T., aneroid, where the following section is reported by Hennen:

¹⁹Report Q, Second Geological Survey of Penna.

	Ft.	In.
Concealed from top of high knob.....	40	0
Sandstone, massive, coarse, brown and pebbly, Saltsburg	10	0
Concealed	15	0
Shale, reddish.....	10	0
Limestone, silicious, shaly, marine fossils, Pine Creek.....	2	0

It was once quarried for agricultural lime by Raymond Bishop on the west side of the high knob (See page 608 of Vol. II(A), State Survey Reports), 2 miles west of Morgans Glade, at an elevation of about 2000' A. T., where Reger reports it carrying gastropod fossils. The quarry had fallen shut when visited in 1912, but he collected a sample from a large boulder at this point, the composition of which, as reported by Messrs. Hite and Krak under Laboratory No. 785H, is as follows:

	Per cent.
Silica (Si O ₂).....	28.45
Ferric Iron (Fe ₂ O ₃).....	3.27
Alumina (Al ₂ O ₃).....	12.11
Calcium Carbonate (Ca CO ₃).....	47.82
Magnesium Carbonate (Mg CO ₃).....	0.94
Phosphoric Acid (P ₂ O ₅).....	0.30
Loss on ignition.....	6.89
Total	99.78

The above results show this stratum too high in sandy and clayey matter at this point to have much economic importance for even agricultural lime.

It has also been quarried for agricultural purposes one mile southward by Eben Liston (See page and reference quoted above), at an elevation of 2160' A. T., aneroid; and by another farmer, one mile north of Valley Point [See page 602 of Vol. II(A)] at an elevation of 2090' A. T., aneroid, where Reger reports it carrying many gastropod fossils.

In Lyon district the following section was measured by Hennen at its crop on the west side of the B. & O. R. R., 1 mile northeast of Newburg, where it has an elevation of 1355' A. T., aneroid:

	Ft.	In.
Shale, brown.....	15	0
Fire clay shale.....	10	0
Shale, gray.....	8	0
Limestone, silicious, Pine Creek.....	0	5
Shale, gray.....0' to	3	0
Sandstone, massive, Buffalo.....	50	0

As with the last limestone described, this ledge is too thin and irregular to have much economic importance except to enhance the fertility of the soil in the immediate region of its crop.

The Buffalo Sandstone.

The Buffalo sandstone²⁰, belonging 10 to 30 feet below the Bakerstown coal, 0 to 5 feet below the Pine Creek limestone and 1 to 5 feet above the Brush Creek limestone, attains a fine development in Preston county. Wherever it comes to the surface it affects the topography even in a more marked manner than the Saltsburg, Grafton and Connellsville ledges, in that it generally forms high steep slopes and escarpments around the hillsides. It is generally bluish gray and steel gray in color, ranging in thickness from 40 to 75 feet and often quite pebbly. In the territory of this report its thickness, character and relative position in the rock column are exhibited in the sections for Kane Creek, Newburg, Albright, Trowbridge, Austen and Fellowsville. Its crop is confined to the area lying between that outlined on Map II for the crops of the Bakerstown and Upper Freeport coals. Therein its position can be readily ascertained at any point by adding 90 feet to the elevation of the top of the Upper Freeport coal as shown by the structure contours on Map II.

Along the southeast edge of Valley Point district, it is this ledge, according to Reger, that caps the high knob, 0.5 mile northwest of Kane Creek station, where it is massive and pebbly, the top coming at an elevation of 2160' A. T., spirit-level.

Southwestward in Lyon district it is this stratum that forms the "falls" in Stony run at Browns Mills, and on down the latter stream it may be observed in a line of cliffs along the valley walls. Its crop may be seen in the railroad cut at the east end of Newburg, where it extends in a massive cliff for 35 feet above road bed.

In the eastern portion of Reno district it is this ledge that strews the ground with large boulders, 3½ miles eastward from

²⁰I. C. White, Rept. Q, Second Geological Survey of Penna.

Fellowsville. Westward on Left fork it makes the steep bluffs, 50 feet high, at the road fork, 1.2 miles northeast of Fellowsville.

According to Reger, it is massive and very pebbly at its crop at the road fork, $\frac{1}{4}$ mile northwest of Marquess, where 40 feet of the upper portion is visible, the top coming at an elevation of 1404' A. T., spirit-level measurement.

Reger measured the following section at an exposure on the west edge of the public highway, 0.3 mile N 10° W of Sinclair:

	Ft.	In.
Sandstone, massive, Buffalo.....	30	0
Shale, dark, Brush Creek.....	3	0
Coal in run, Brush Creek.....	..	..
(Elevation of coal, 1430' B-A. T.)		

No quarries were observed on this ledge in Preston county.

The Brush Creek Limestone and Shale.

The fossiliferous Brush Creek limestone²¹, belonging from a few inches to 5 feet below the Buffalo sandstone and about the same interval above the coal of the same name, is fairly persistent in Preston. Between this limestone and the coal next below of the same name there generally occurs 3 to 10 feet of dark or black shale that often replaces the limestone entirely and frequently carries marine fossils in its upper half and a fossil flora in its basal portion. This shale has also been designated the **Brush Creek**, and is much more persistent in this county than the limestone. The several sections given below under the description of the Brush Creek coal, exhibit the thickness and character of these formations.

In Grant district the crop of the fossiliferous shale is well exposed at the crossroads, 1 mile west of Clifton Mills, immediately above 15 inches of Brush Creek coal. Here it is 15 feet thick, carrying many marine fossils and coming at an elevation of 1834' A. T., spirit-level measurement. The limestone is missing entirely.

A short distance north of the road, 1 mile westward from Bruceton, the shale crops in the field at an elevation of 1800' A. T., aneroid, 100 feet above the blossom of the Upper Free-

²¹I. C. White, Rept. Q, Second Geological Survey of Penna.

port coal in the road and about the same distance below a mine on the crop of the Bakerstown coal near the summit of the knob immediately to the northwest. Here it carries marine fossils.

In Lyon district the following section was measured by Reger at its crop in the road, 0.6 mile eastward from Gladesville:

	Feet.
Sandstone, flaggy, Buffalo.....	20
Shale, dark, with microscopic marine fossils at base, Brush Creek.....	20
Coal, Brush Creek, 6".....	0.5
Fire clay.....	..
(Elevation of shale, 1850' A. T. aneroid).	

Two miles southeastward from Gladesville, Hennen reports 5 feet of marine fossiliferous shale at this horizon in the great earth slide at the road fork on Martin run, 0.6 mile northwest of the mouth of Martin run, but no limestone (See section for this point given on a subsequent page under the description of the Brush Creek coal).

The following section was measured at the crop of these formations along the west hillside at Stony run, 0.5 mile southwest of Browns Mills:

	Ft.	In.
Sandstone, massive, Buffalo.....	30	0
Shale, dark.....	15	0
Limestone, Brush Creek, carrying many fossil gastropods, crinoids, etc.....	0	4
Coal, Brush Creek (1590' B-A. T.).....	1	0
Fire clay, plastic.....	10	0
Fire clay, flinty, reddish.....	10	0
Shale, limy, ferriferous ("Johnstown Iron Ore" horizon).....	30	0
Limestone, nodular, ferriferous, with fresh water fossils, to bed Stony run.....	5	0

The limestone is too thin and irregular to have any economic importance, but it is of great scientific interest on account of the marine fossil fauna therein preserved.

The Brush Creek Coal.

The Brush Creek coal²², belonging immediately at the base of the Brush Creek shale and 75 to 100 feet above the Upper

²²I. C. White, Report Q, Second Geological Survey of Penna



PLATE X.—Looking east down Rhine Creek, showing Shaffer Mountain capped with Pottsville rocks on left and Aurora on right. The smooth topography in the foreground represents the junction of the Pocono and Greenbrier rocks.

Photo by E. E. Knight

Freeport coal, is a thin—6 to 18 inches—single-bedded and very persistent vein in Preston county. Its crop follows roughly the same regions as that outlined on Map II for the Upper Freeport bed. Its thickness and relative position in the rock column are exhibited in the sections for Clifton Mills, Newburg, Trowbridge, Austen and Fellowsville.

In Grant district this coal—8 inches thick—crops in the road 1 mile southeast of Laurel Church and one-fourth mile east of the residence of T. E. Benson, at an elevation of 1785' A. T., aneroid, 75 to 100 feet below an old digging in the Bakerstown coal on the summit of a knob due westward. Eastward in the same district to the crossroads, 1 mile west of Clifton Mills, this coal is 15 inches thick, coming directly at the base of the fossiliferous Brush Creek shale and at an elevation of 1833' A. T., spirit-level measurement.

In the same district it is this bed that crops in the road at an elevation of 1810' A. T., aneroid, in the east edge of Brandonville, where it is only 12 inches thick.

In Pleasant district this vein crops along the east hillside of Big Sandy creek, 1 mile northeast of the mouth of the latter stream, where it is 1 foot thick as shown in the section 2 miles southwest of Rockville, page 82.

In Valley district this coal is exposed at several points along the Ligonier Basin. It is this bed that crops in the road 0.4 mile west of Burk station on the M. & K. R. R., at an elevation of 1750' A. T., aneroid, where it has its usual thickness. In the extreme eastern part of the same district it crops in the road on the Valley-Kingwood district line, 0.3 mile northwest of the summit of Mt. Phoebe, where it is only 6 inches thick.

In Lyon district this coal is only 12 inches thick at its crop along the west hillside of Stony run, 0.5 mile southwest of Browns Mills, coming here directly below the fossiliferous Brush Creek limestone.

In the same district the following section was measured by Hennen at its crop in the great land slide, 2 miles southeast of Gladesville, at the road fork on Martins run:

	Ft.	In.
Sandstone, massive, Buffalo.....	15	0
Shale, bluish gray, weathering red.....	20	0
Slate, black, marine fossil shells, Brush Creek	5	0

	Ft.	In.
Coal	0' 2"	
Slate, gray.....	0 3	
Slate, black.....	0 2	
Slate, gray.....	0 3	
Coal, good.....	1 6	
} Brush Creek... 2 4		
} (Elev., 1540' B-A. T.)		
Fire clay shale.....	10	0
Shale, yellowish brown.....	5	0
Clay, flinty, reddish brown.....	15	0
Fire clay shale, gray.....	5	0

The following section was made at a digging in this bed on the west side of Cooks run, 0.8 mile northeast of Independence:

	Ft.	In.
Sandstone, massive, coarse, brown, Buffalo..	..	..
Slate, black, with fossil plants, Brush Creek	1	0
Coal, slaty, Brush Creek	1	0
Fire clay shale.....	..	..
(Elevation of coal, 1340' A. T., spirit-level).		

Hennen obtained the following section at its crop along the B. & O. R. R. grade immediately west of Hiorra:

	Ft.	In.
Shale, dark.....	8	0
Coal, Brush Creek	0	8½
Fire clay, plastic.....	8	0
Fire clay, flinty.....	5	0
Fire clay, plastic.....	3	0
(Elevation of coal, 1465' B-A. T.)		

In Kingwood district the crop of this coal may be observed in the road at Oak Grove Church, $\frac{3}{4}$ mile southeast of Manown station, at an elevation of 2375' A. T., aneroid.

Eastward at Albright this coal crops in the bed of Cheat river at the highway bridge over the latter, where it is reported by a resident—Mr. A. J. Snider—18 inches thick at the east abutment.

It is only 10 inches thick at its crop in the road 1 mile northwest of Snyder, where it comes at an elevation of 2000' A. T., aneroid.

In Reno district this coal is only 7 inches thick at its crop in the road 300 to 500 feet northeast of Dent, where it comes at an elevation of 1325' A. T., aneroid.

Reger obtained the following section at its crop in the road, 0.6 mile northeast of Marquess:

	Ft.	In.
Sandstone, Buffalo.....	30	0
Shale, gray.....	0	3
Coal, good, Brush Creek.....	0	9
Shale, gray.....	3	0
Concealed to Left fork.....	8	0
(Elevation of coal, 1375' A. T., aneroid).		

At Sinclair it is this vein that crops 30 feet west of the residence of W. A. Bolyard, at an elevation of 1485' A. T., spirit-level, where it does not exceed 12 inches in thickness.

From the foregoing data it will readily be observed that the Brush Creek coal in Preston is too thin to have any economic importance, but it is of interest in that it is a great aid, owing to its persistence, in correlating the basal formations of the Conemaugh series as well as the upper rocks of the Allegheny.

There frequently occurs a fine quality of **fire clay** immediately under the last coal described, as will be readily seen in the section given above for the Brush Creek coal at Hiorra, where the flint and plastic clays have a total thickness of 16 feet. The reader is referred to an analysis of this clay from near Webster, Taylor county, as published on page 318 of the Monongalia-Marion-Taylor report of the State Geological Survey.

The Mahoning Sandstone Stage.

The next 75 to 100 feet of measures, intervening between the Brush Creek coal and the Uffington shale, are what is known as the Mahoning Sandstone Stage²³, being made up of the following succession in descending order:

Upper Mahoning Sandstone.
Mahoning Coal.
Thornton Fire Clay.
Lower Mahoning Sandstone.

²³I. C. White. Vol. II, p. 305; and Monongalia-Marion-Taylor Rept. W. Va. Geol. Survey, p. 318; 1913.

These are all represented in Preston county with the possible exception of the Mahoning coal.

The Mahoning Sandstones.—These sandstones play a conspicuous part in shaping the topography in a manner similar to the Buffalo ledge above, and both frequently coalesce into one unbroken cliff, cutting out the intervening coal and fire clay entirely, forming the "Big Dunkard Sand" of the oil well drillers of the Pennsylvania and West Virginia oil fields. The sections for Rockville NW, Rockville SW, Kane Creek, Gladesville, Newburg and Austen exhibit their thickness, character and relative position in the rock column. Their crop follows closely the same regions outlined on Map II for the Upper Freeport coal. The large area of the latter bed preserved from erosion is due largely to the protective cover formed by these sandstones.

No quarries were observed on these ledges, but their generally massive and homogeneous structure along with durable qualities especially adapts them to building purposes.

The Mahoning coal²⁴, belonging immediately under the Upper Mahoning sandstone, was not observed in the county.

The Thornton Fire Clay.—The Thornton fire clay²⁵, belonging in the interval between the two Mahoning sandstones, immediately below the last coal mentioned and 30 to 40 feet above the base of the Conemaugh series, is fairly persistent and of excellent quality in Preston. It attains a fine development at its type locality in Taylor county just west of the Preston line, where it has been mined extensively to furnish the raw clay for a fire brick plant at this place.

In Lyon district the following section was measured by Hennen at its crop in the bed of Stony run, $\frac{1}{4}$ mile southwest of Browns Mills:

	Feet.
Sandstone, massive, Buffalo.....	50
Shale, black.....	3
Shale, black and hard, marine shells 1' }	9
Slate, black, fossil plants.....8 }	
Coal blossom, trace, Brush Creek.....	0
Fire clay, concealed and gray shale.....	30
Sandstone, bluish gray, micaceous, flaggy, Upper Mahoning	15
Fire clay, hard, Thornton, to bed run.....	5

²⁴I. C. White, Bull. No. 65, U. S. G. Survey, p. 94; 1891.

²⁵I. C. White, Vol. II, W. Va. Geol. Survey, pp. 322-323; 1903.

A sample for analysis was collected from the basal fire clay, the composition and character of which are discussed in a subsequent chapter under "Clays".

The Browns Mills and Austen sections of the Conemaugh series, both published on page 115, exhibit its thickness, character and relative position in the rock column. Both reveal valuable deposits of clay.

In the extreme eastern edge of Lyon district, Reger measured the following section at its crop along the Baltimore & Ohio R. R. grade, a few hundred feet east of Austen station:

	Feet.
Shale, sandy and yellow.....	15
Fire clay, flinty, Thornton.....	8
Sandstone, massive, Lower Mahoning.....	50
Shale, dark, Uffington.....	10
Coal, with partings, Upper Freeport.....	6
(Elevation of Thornton fire clay, 1660' A. T., aneroid).	

A sample of the clay for analysis was collected here, the composition of which is found in a subsequent chapter under "Clays".

In Kingwood district a flinty clay crops at this horizon along the ridge road, 1.5 miles S 10° W of Manown station, at an elevation of 2280' A. T., aneroid; and again, along the public road, 1 mile southwestward from the last exposure mentioned, where it is 10 feet thick, 30 to 40 feet above the Upper Freeport coal, at an elevation of 2110' A. T., aneroid.

In the same district a flint clay at this horizon crops in the road one-half mile northwest of the east portal of the railroad tunnel at Tunnelton, at an elevation of 2080' A. T., aneroid; and again along the public road, 1 mile east of the Tunnelton railroad station, at an elevation of 1880' A. T., aneroid.

The Uffington Shale.

The Uffington shale²⁶, belonging at the very base of the Conemaugh series, is quite frequently represented in Preston, although it sometimes happens that it is cut away entirely by the Mahoning sandstones. The section given for Gladesville and that above for the Thornton fire clay at Austen, exhibit its

²⁶I. C. White, Vol. II, W. Va. Geol. Survey, pp. 323-325; 1903.

thickness and character in this county. The formation has no special economic value, but is of scientific interest on account of the fossil flora generally therein preserved.

The fossil Fauna of the Conemaugh series will be described by Dr. W. Armstrong Price, Paleontologist of the Survey, in a later chapter of this Report.

CHAPTER VII.

STRATIGRAPHY—THE ALLEGHENY SERIES

GENERAL ACCOUNT AND SECTION.

The Allegheny series includes that portion of the Carboniferous rocks lying between the base of the Uffington shale above, and the top of the Homewood sandstone below. A general description of the same by I. C. White is published in Vol. II of the State Survey reports, pages 331-341.

The series, as above limited, is capped at the top with the widely persistent and important Upper Freeport coal, and as observed in Preston county, contains several valuable beds of fire clay, limestone and coal, with shale and 4 or 5 massive sandstones. No red shales appear. In fact, a decided change in the lithology of the strata takes place in descending order in the Allegheny series, the sandstones becoming harder, more massive and often quite pebbly, the same being accompanied by a marked change in the character of the imbedded fossil flora.

The maximum thickness of the series observed in Preston is about 260 feet. The crop of these measures is outlined in detail on Map II where it is shown to be confined to the north-west half of the county and to a small area southwestward from the Maryland line at Corinth.

The topography of the series is generally the same, the hills being usually terraced with a series of benches widely parallel and fairly close together, the intervening slopes often being too steep and rugged for convenient tillage. Where protected from erosion the beds make a fairly rich soil and form excellent grazing lands. Frequently the Lower Freeport and Clarion sandstones make great cliffs around the hillsides.

The following general section of the Allegheny series has

been compiled from observations made throughout the county, and is quite similar to that published for the same formation in the Report for Monongalia, Marion and Taylor counties:

General Section of Allegheny Series for Preston County.

	Thickness Feet.	Total Feet.
Coal, Upper Freeport.....	6	6
Fire clay, Bolivar.....	10	16
Limestone, Upper Freeport.....	5	21
Sandstone, Upper Freeport, sometimes containing Middle Freeport coal.....	40	61
Coal, Lower Freeport.....	2	63
Fire clay and shale.....	2	65
Limestone, Lower Freeport.....	5	70
Sandstone, Lower Freeport, Upper Division	40	110
Coal, Upper Kittanning.....	3	113
Fire clay, Upper Kittanning.....	7	120
Limestone, Johnstown cement.....	2	122
Fire clay, Hardman.....	10	132
Sandstone, Lower Freeport, Lower Division	30	162
Coal, Middle Kittanning.....	2	164
Shale, sandy	16	180
Coal, Lower Kittanning.....	5	185
Fire clay, Lower Kittanning.....	5	190
Shale, with iron ore nuggets.....	30	220
Limestone, Vanport (Ferriferous).....	1	221
Sandstone, Clarion.....	30	251
Coal, Clarion	2	253
Fire clay, Clarion.....	6	259
Coal, Brookville (seldom found).....	1	260
Homewood sandstone.		

Of course, the foregoing section does not hold good in every portion of the county, but the intervals between important strata such as coals and limestones remain fairly constant. Several sections, either partial or complete from actual measurement of the Allegheny series, are given in Chapter IV for Albright, Amblersburg, Beaverhole, Brandonville, Gladesville—2 miles SE, Kane Creek, Manheim, Nebo Church, Newburg, Rockville, Rowlesburg, Threefork Creek and Trowbridge.

LOCAL SECTION.

In addition to the foregoing section, the following was carefully measured with hand-level at the east portal of the new B. & O. R. R. tunnel at the southwest border of Tunnel-ton:

Tunnelton (Kingwood) Tunnel Section.

	Thickness Feet.	Total Feet.
Shale, gray, Uffington.....		
Coal, bony.....1' 5"	3	
Coal, soft.....2		
Shale, gray, "Little Slate"...0		
Coal, soft.....1		
Shale, gray, "Big Slate" 1	5	
Slate, black.....0		
Coal 0		
Slate 0		
Coal 0	9	
Shale, gray and fire clay.....		
Limestone, silicious, nodular, Upper Freeport		
Fire clay, plastic, Bolivar.....		
Sandstone, gray, and hard, Upper Freeport	10.5	49.5
Coal 0' 11"	2	
Slate, gray.....0		
Coal 0		
Shale, gray.....		
Sandstone, limy.....	4.5	61.0
Fire clay shale to railroad grade, east portal new tunnel.....	12	73

The above section is important in that it reveals the true position of the Upper Freeport limestone, Bolivar fire clay, Upper Freeport sandstone and Lower Freeport coal.

DESCRIPTION OF THE FORMATIONS.

The Upper Freeport Coal.

The topmost formation of the Allegheny series is the Upper Freeport coal. It is always multiple-bedded, a characteristic feature in Preston and other portions of West Virginia. Map II exhibits its crop in the northwest half of the county and in a small area southwestward from the Maryland line at Corinth. As in Monongalia, Marion and Taylor counties, this bed has a peculiar structure which aids very materially in its identification, the vein being subdivided by partings into several definite members which may be grouped as follows:

1. Top coal.
2. Main bench.
3. Parting—Little Slate.
4. Lower bench—Mining Ply.
5. Parting—Big Slate.
6. Bottom coal.

The following may be taken as a general type section of the bed as exhibited at the 26 commercial mines and other country banks in the county:

	Ft.	In.
1. Coal, hard, sulphurous, "top".....18" to	2	0
2. Coal, soft, "main bench".....2' 10" to	3	0
3. Slate, dark gray, "little".....	0	2
4. Coal, soft, with thin slate 3" above bottom, "mining ply".....	1	4
5. Slate, dark gray, "big".....12" to	5	0
6. Coal, hard, sulphurous, "bottom"..12" to	1	6
Total	13	0

The "main bench" and "mining ply" are much lower in sulphur than the other members, and constitute the main source of supply of the high grade coking and by-product coal from this vein.

The coal attains minable dimensions and purity in every district of the county except Union. Its thickness and relative position in the rock column are exhibited in the general sections in Chapter IV, and in the Tunnelton Tunnel section, this chapter. Its distribution, character, composition, calorific value and fuel ratio will be discussed fully in Chapter XII, along with which will be given an estimate of the probable minable area and tonnage by magisterial districts.

The Bolivar Fire Clay.

A fairly persistent fire clay, known as the **Bolivar**, lies immediately below the last coal described. It is generally a hard flinty clay, ranging in thickness from 5 to 20 feet, and frequently replaces the Upper Freeport limestone.

In Preston its thickness and relative position in the rock column are exhibited in the general sections in Chapter IV and in the Tunnelton Tunnel section. Its crop follows closely the same area as that outlined for the Upper Freeport coal on Map II.

In the western portion of Grant district, 10 to 15 feet of good flint fire clay crops at this horizon in the public road, ½ mile due south of Pisgah, at an elevation of 1960' A. T., aneroid, where a sample for analysis was collected by Hennen.

the composition of which as reported by Messrs. Hite and Krak is as follows:

	Per cent.
Silica (Si O_2).....	59.94
Ferric Iron ($\text{Fe}_2 \text{O}_3$).....	1.17
Alumina ($\text{Al}_2 \text{O}_3$).....	26.57
Lime (Ca O).....	0.27
Magnesia (Mg O).....	0.02
Soda ($\text{Na}_2 \text{O}$).....	0.27
Potassa ($\text{K}_2 \text{O}$).....	0.60
Titanium (Ti O_2).....	0.92
Phosphoric Acid ($\text{P}_2 \text{O}_5$).....	0.66
Moisture ($\text{H}_2 \text{O}$).....	1.14
Loss on ignition.....	9.07
Total	100.63

The results reveal a high grade clay which owing to the low percentage of fusible elements is adapted to the manufacture of fire brick and other ware requiring a highly refractory character.

This fire clay is quite generally present throughout the crop of its horizon, either in plastic or flinty form, and should furnish an abundance of raw clay for the manufacture of the several kinds of brick.

The Upper Freeport Limestone.

At 5 to 20 feet below the Upper Freeport coal belongs a calcareous stratum, ranging in thickness from 5 to 15 feet and known as the **Upper Freeport limestone**. It is evidently a fresh or brackish water deposit, since no marine fossils have been observed in the same. Its crop should follow closely that outlined on Map II for the coal of the same name. Its thickness and relative position in the rock column are exhibited in the sections in Chapter IV for Newburg and Rowlesburg; the Tunnelton Tunnel section on a preceding page of this chapter; and in the logs of core test borings Nos. 37, 63 and 65 in Chapter XII.

In Grant district this stratum attains a fair development and has frequently been quarried by farmers to be burned into agricultural lime. Reger reports the bed as having been once mined in the northeast portion of the district, $\frac{1}{2}$ mile south-

west of Five Forks, on the Werlen Miller farm, at an elevation of 2160' A. T., aneroid, where it is 6 feet thick.

One mile and a half southwestward, he reports this limestone 18 inches thick at the Scott Thomas mine in the Upper Freeport coal, 18 inches below the latter bed, and 45 to 50 feet above a quarry in the Lower Freeport limestone. This is the only place noted in the county where both the Freeport limestones were exposed in good development in the same hill.

The following section was measured at a mine on the Jas. Michael Heirs farm, 1.6 miles southwest of Bruceton Mills:

	Ft.	In.
Concealed	..	..
Shale, dark, sandy and flaggy.....	8	0
Coal 1' 11" }		
Slate, black.....0 1 } Upper Freeport.	3	1
Coal 1 1 }		
Slate and concealed.....	2	0
Shale, dark, sandy.....	2	0
Limestone, dark gray, fresh water fossils,		
Upper Freeport.....	4	0
(Elevation of limestone, 1660' B-A. T.)		

In the southern point of Grant district the Upper Freeport ledge has been quarried for agricultural purposes along the west side of Big Sandy creek on the Evan King and L. Birtcher farms at an elevation of 1625' A. T., aneroid, where it is reported 7 feet thick and of good quality.

It has also been quarried quite extensively in the western portion of Pleasant district. Reger collected a sample for analysis and measured the following section at the John A. Wolfe quarry on this ledge, 1.5 miles southwest of Rockville:

	Ft.	In.
1. Sandstone, shaly.....	5	0
2. Shale, brown.....	10	0
3. Coal, Upper Freeport?.....0" to	0	1
4. Shale, limy.....	4	0
5. Limestone, good, hard, Upper Freeport..	8	6
6. Concealed	..	..

The limestone has been quarried here by direct mining into the hill, leaving about 1 foot of the top of No. 5 for roof. The composition of the sample as reported by Messrs. Hite and Krak, under Laboratory No. 746H, is as follows:

	Per cent.
Silica (Si O_2).....	4.27
Ferric Iron ($\text{Fe}_2 \text{O}_3$).....	1.40
Alumina ($\text{Al}_2 \text{O}_3$).....	0.95
Calcium Carbonate (Ca CO_3).....	91.39
Magnesium Carbonate (Mg CO_3).....	2.85
Phosphoric Acid (P_2O_5).....	0.08
Loss on ignition.....	0.00
Total	100.94

One mile and a half west of Rockville the following section was measured by Hennen at the Silas Metheny quarry in what appears to be the Upper Freeport limestone:

	Ft.	In.
Sandstone, massive, Mahoning.....	..	..
Concealed	10	0
Shale, yellow.....	10	0
Coal, slaty, Upper Freeport?.....	0	2
Fire clay, dark gray.....	3	0
Sandstone, shaly.....	10	0
Shale, dark, sandy.....	8	0
Limestone, dark gray, Upper Freeport, reported	8	0
(Elevation of limestone, 1610' B-A. T.)		

In this section and in that preceding it is possible that the Upper Freeport coal belongs in the concealed interval 30 feet or more above the base of the limestone, since this vein is present in fine development on the L. Birtcher farm slightly less than 1 mile southwestward.

A sample for analysis was collected and the following section measured by Reger at its crop at an old iron ore digging near the Pleasant-Portland district line on the east hillside of Muddy creek, 1.4 miles due west of Hayden.

	Ft.	In.
1. Sandstone, flaggy.....	..	..
2. Shale, brown, and concealed.....	10	0
3. Coal, Upper Freeport, thickness concealed	0	0
4. Concealed	5	0
5. Sandstone, massive.....	5	0
6. Shale, dark, streak.....	0	0
7. Limestone, ferriiferous, quarried for ore once	0	6
8. Shale, gray, with boulders of iron carbonate	6	0
9. Fire clay, flint, Bolivar.....	3	0

	Ft.	In.
10. Sandstone	2	0
11. Limestone, dark gray, hard, carbonaceous, with plant fossils, Upper Freeport	6	0
12. Concealed	5	0
13. Coal, Lower Freeport.....	0	8
(Elevation of Upper Freeport limestone, 1475').		

The composition of the sample from No. 11 of the above section as reported by Messrs. Hite and Krak under Laboratory No. 803H is as follows:

	Per cent.
Silica (Si O_2).....	9.11
Ferric Iron ($\text{Fe}_2 \text{O}_3$).....	2.08
Alumina ($\text{Al}_2 \text{O}_3$).....	2.12
Calcium Carbonate (Ca CO_3).....	82.59
Magnesium Carbonate (Mg CO_3).....	1.97
Phosphoric Acid ($\text{P}_2 \text{O}_5$).....	0.20
Loss on ignition.....	1.77
Total	99.84

A sample was also collected by Reger from No. 7 of the above section, the composition of which is found under "Iron Ore" in Chapter XIV.

In the western edge of Lyon district, this limestone was once quarried quite extensively along the public road immediately southeast of Irondale, both for ore and fluxing material for use in the old iron furnaces at this place. Here Hennen collected a sample for analysis and measured the following section at one of the numerous openings:

	Ft.	In.
1. Sandstone, massive, visible.....	15	0
2. Shale, sandy.....	5	0
3. Limestone, gray and hard, in layers, with gray shale between, Upper Freeport	10	0
4. Shale, gray, with ferriferous nuggets....	3	0
5. Concealed	..	..

The composition of the sample from No. 3 only of section is reported under Laboratory No. 577H by Messrs. Hite and Krak as follows:

	Per cent.
Silica (Si O_2).....	9.22
Ferric Iron (Fe_2O_3).....	6.74
Alumina ($\text{Al}_2 \text{O}_3$).....	2.90
Calcium Carbonate (Ca CO_3).....	62.11
Magnesium Carbonate (Mg CO_3).....	14.63
Phosphoric Acid (P_2O_5).....	0.26
Loss on ignition.....	3.88
Total	99.74

The chemical tests show this ledge too high in sandy and clayey matter to burn into a good commercial lime. However, it gives very satisfactory results to the farmers when burned into an agricultural lime, and owing to its hardness should make a fair road material. It also adds greatly to the fertility of the soil in the immediate region of its crop.

The Upper Freeport Sandstone.

A massive gray and brown sandstone, known as the Upper Freeport, sometimes occupies most of the interval separating the Upper and Lower Freeport coals as noted in the Brandonville section, page 80. In general, however, its horizon is more frequently represented by sandy shales and flaggy sandstones, the ledge not attaining sufficient development to warrant further description.

The Lower Freeport Coal.

An important coal bed, known as the Lower Freeport, occurs in Preston at 45 to 60 feet below the top of the Allegheny series. It is always multiple-bedded and ranges in thickness from 12 inches to 5 feet. Its relative position in the rock column is exhibited in the sections in Chapter IV for Brandonville, Clifton Mills, Nebo Church, Rockville south, and Kane Creek, and in the logs of coal test boring No. 42, 1 mile south of Masontown; No. 63, 1 mile northeast of Independence; and No. 74B, 1.8 miles east of Manown.

This vein apparently only attains minable dimensions, purity and regularity in Grant and Pleasant districts. Although nearly always present at its proper horizon in other portions

of the county, it is generally too thin and worthless for mining purposes.

In the eastern half of Grant district, this coal has been opened at several points by farmers for domestic fuel. The following section was measured by Hennen at the Jeremiah Guthrie quarry in the Lower Freeport limestone, along the west hillside of Big Sandy, 2 miles northward from Bruceton Mills:

	Ft.	In.
Shale	1	0
Black slate.....	3	0
Shale	8	0
Sandstone, hard.....	0	6
Black slate.....	0	5
Coal, soft.....0' 5 "	} Lower Freeport.... (Elev., 1615' B-A. T.)	4 8½
Slate, black, cannelly ...0 2		
Coal, soft.....1 8		
Slate, black....0 1½		
Coal, soft.....1 5		
Slate, black....0 1½		
Coal 0 5		
Slate, black....0 0½		
Coal 0 4	} Lower Freeport.... (Elev., 1615' B-A. T.)	4 8½
Shale, gray.....		
Limestone, dark gray and hard, Lower Free- port		
	6	0

The Brandonville section, page 80, attests the correctness of the correlations, since the latter is formed from the logs of Core Test Borings Nos. 6 and 7 on Map II, close by, and the coal at 64' 10" from the top of the section is undoubtedly the same as that given above.

Reger collected a sample for analysis and measured the following section at an opening along the southern edge of the eastern half of Grant district, 1 mile west of Hazelton:

Amos Moyers Mine.—No. 55 on Map II.

	Ft.	In.
1. Coal 0' 4" }	} Lower Freeport....	2 11
2. Slate, black.....0 1		
3. Coal, soft.....1 6		
4. Slate, black.....0 2		
5. Coal, soft.....0 4		
6. Shale, hard, gray...0 2		
7. Coal, soft.....0 4 }	} Lower Freeport....	2 11
8. Fire clay, gray, with limestone nodules..		
9. Limestone, Lower Freeport.....		
	2	0
	5	0
(Elevation of coal, 1895' A. T., aneroid).		

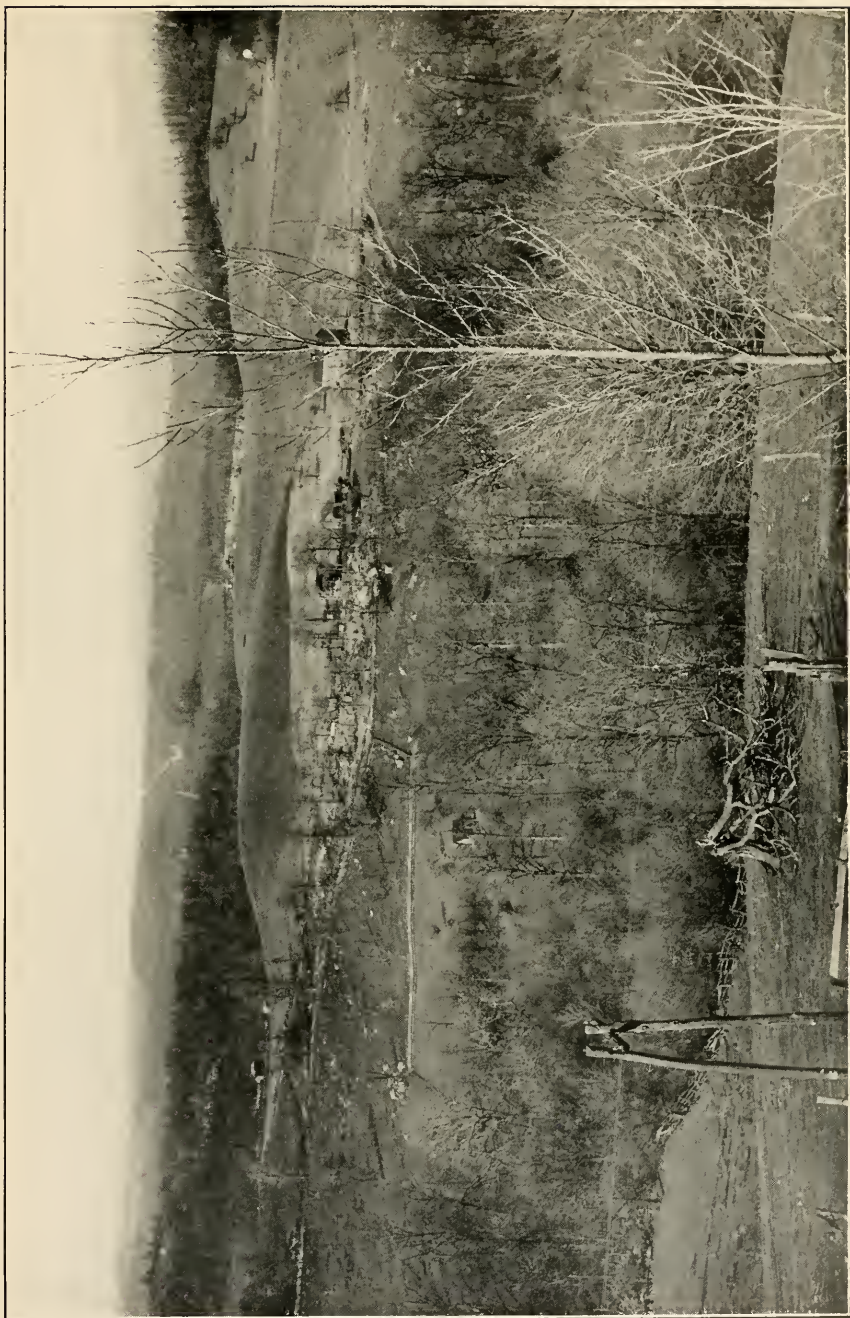


PLATE XI.—Looking north from Kingwood, showing topography of Conemaugh Series and Pot'sville capping Briery Mountain in extreme right background.

Photo by E. E. Knight

No. 3 only of section was being mined at this opening, the composition and calorific value of which as reported by Messrs. Hite and Krak are found under No. 55 in the table of coal analyses at the end of Chapter XII.

In the northeast corner of Grant district and one mile southeast of Glade Farms, Hennen measured the following section at an exposure in the Truman Frazee quarry in the Lower Freeport limestone, the coal coming 50 to 60 feet below an opening in the Upper Freeport coal:

	Ft.	In.
1. Shale, dark and sandy.....	4	0
2. Slate, black.....	1	0
3. Shale, dark, with iron ore nodules.....	1	6
4. Coal, soft.....1' 10"	3	2
5. Shale, black.....0 5		
6. Coal, slaty.....0 7		
7. Slate, black.....0 1		
8. Coal 0 3		
9. Slate, dark.....	0	6
10. Limestone, dark gray and hard, Lower Freeport, quarried here for agricultural purposes.....	4	0
(Elevation of coal, 2090' A. T., aneroid).		

Two and a half miles southeastward and one-half mile east of the W. Va.-Md. State line the following section was measured at an exposure in the Frank Humberson quarry in the Lower Freeport limestone:

	Ft.	In.
1. Concealed	..	..
2. Coal 1' 0"	3	9
3. Shale, gray.....0 7		
4. Coal 0 3		
5. Slate, black, coaly 0 10		
6. Coal, bony.....0 6	3	0
7. Slate 0 1		
8. Coal, soft.....0 6		
9. Shale, gray.....	3	0

			Ft.	In.
10.	Limestone	1' 6"		
11.	Shale, gray and limy	3 0		
12.	Limestone...	6" to 1 6		
13.	Shale, limy.....	1 3		
14.	Limestone, massive, dark gray.....	5 0	Lower Free- port Limestone..	17 6
15.	Shale, gray, limy..	2 0		
16.	Limestone, dark gray, with fresh water fossils, spiroribis, to base quarry...	3 0		

(Elevation of coal, 2315' A. T., aneroid).

The above section not only reveals the multiple-bedded character of the Lower Freeport coal, but also an extraordinary development of the Lower Freeport limestone.

One mile and a quarter southwestward at the Joshua Fike quarry, this coal is only 23" thick with 10" of black, coaly shale 6" below the top, the whole coming 3 feet above 9 feet of Lower Freeport limestone. Here the coal and limestone at the quarries on Evans Hill and $\frac{1}{2}$ mile eastward were erroneously placed by G. C. Martin¹ high up in the Conemaugh series.

Passing westward in Grant district to the east hillside of Barnes run, 1.7 miles southeast of Brandonville, an old abandoned opening in the Lower Freeport coal is found on the John Frankhouse farm, 45 feet below an old mine in the Upper Freeport bed, where the following section is exposed:

			Ft.	In.
Coal, good	1' 2"	Lower Freeport	2	0
Coal with slate layers..	0 10			

(Elevation, 1840' A. T., aneroid).

In the western half of Grant district, Reger reports the following section at an old mine in this coal on the Joe Davis farm, 1 mile northwest of Rockville:

¹Geologic Map accompanying Garrett County Report, Md. Geol. Survey; 1902.

	Ft.	In.	
Sandstone, massive.....	10	0	
Slate	3	0	
Coal, good.....1' 7"	} Lower Freeport	2 4	
Slate			0 1
Coal			0 8
Shale			
(Elevation of coal, 1570' A. T., aneroid).			

The coal section is as furnished Reger by Joe Davis.

In the northern edge of Portland district the following section was measured by Hennen at an opening in the Lower Freeport coal on Staley Liston's farm, 1.4 miles westward from Morgans Glade, 50 feet below an old abandoned opening in the Upper Freeport bed:

	Ft.	In.
1. Shale, dark, and sandy roof.....	..	..
2. Coal 0' 4 "	} Lower Freeport coal... (Elev., 1680' A. T., aneroid).	2½
3. Slate, black...0 2		
4. Coal, soft....2 4		
5. Slate, black...0 1		
6. Coal, soft....1 2	} Lower Freeport coal... (Elev., 1680' A. T., aneroid).	2½
7. Slate, black...0 1		
8. Coal, hard....0 6		
9. Slate, black...0 0½		
10. Coal, hard....0 6	} Lower Freeport coal... (Elev., 1680' A. T., aneroid).	2½
11. Slate, pavement.....		

Nos. 8 to 11 inclusive of the above section were concealed by water on date of visit by Hennen and the thicknesses recorded for these are as furnished by Staley Liston.

During 1906 a sample for analysis was collected by Hennen at a mine in this coal in the southern half of Pleasant district on the west hillside of Muddy creek at Guseman, at an elevation of 1660' A. T., aneroid. 50 feet below another mine on the same farm in the Upper Freeport vein. The results obtained here as published on page 605 of Vol. II(A) of the State Survey reports with slight modifications are as follows:

Geo. Jefferson Mine, Lower Freeport Coal, No. 56 on Map II.

At Entrance.	Ft.	In.	At Working Face	Ft.	In.
1. Sandstone, flaggy	..	..	1. Sandstone, flaggy	..	..
2. Coal	0	11	2. Coal, bony.....	1	9
3. Shale	0	3	3. Coal, good.....	1	7
4. Coal, bony.....	1	9	4. Shale	0	3
5. Coal, good.....	1	3	5. Coal, bony.....	0	9
6. Shale	0	3			
7. Coal, bony.....	0	10	Total	4	4
			6. Fire clay.....	..	..
Total	5	3			

Analysis.

(2), (3), and (5) at Working Face.

	Per cent.
Moisture	1.27
Volatile Matter.....	22.33
Fixed Carbon.....	55.14
Ash	21.26
Total	100.00
Sulphur	3.95
Phosphorus	0.002

"This analysis reveals a high percentage of ash, due to the 1' 9" of bony coal included in the sample taken down. The coal appears to improve as the heading is driven farther under cover. The sulphur also seems high for coking purposes. This bed is accessible to drift openings over a considerable portion of this field, and in the Muddy Creek region should afford quite a large output of good coal."

Three-fourths mile N 10° W of Guseman the following section was measured by Hennen at an opening in the Lower Freeport coal on the Thomas Sines farm at an elevation of 1775' A. T., aneroid:

		Ft.	In.
Slate		..	..
Coal, good.....3' 2"	} Upper		
Slate			
Coal, good.....0 1	} Freeport	4	5
Coal, good.....1 2			
Slate and concealed, and sandstone, flaggy..		22	6
Shale, dark and sandy.....		2	6
Coal, bony.....1' 1"	} Lower		
Slate, gray.....0 6			
Coal, streaks of bone...2 4	} Freeport coal	5	4
Coal, good.....1 5			
Concealed		..	..

At the old Elias Ringer opening in this bed, 1 mile N 15° E of Guseman, corresponding to Opening No. 15 on page 604 of Vol. II(A) of the State Survey reports, Reger obtained the following:

		Ft.	In.
Shale, brown.....		..	..
Coal, slaty.....1' 4"	} Lower		
Sandstone, hard.....0 9			
Slate, black with shale. 1 6.	} Freeport	5	7
Coal, thickness concealed,			
about 2 0			

(Elevation of coal, 1775' A. T., aneroid).

In the western portion of Pleasant district, an old abandoned digging occurs in this bed, 0.8 mile S. 15° W. of Rock-

ville at an elevation of 1685' A. T., aneroid. The coal was concealed by debris at this opening.

Along the southwest border of the same district this bed was once opened near the crest of the Preston anticline, 2.4 miles south of Hudson, on the J. B. Graham land at an elevation of 2105' A. T., aneroid, 32 feet by hand-level below another old digging in the Upper Freeport bed. The lower bed had fallen shut, but Mr. Graham reports it 3 feet in thickness.

In the northeast portion of Valley district the Lower Freeport coal was once mined for local domestic supply, 1.7 miles eastward from Masontown on the Clyde Strahan land. No section was obtained here, since this opening had also fallen shut.

In Kingwood district this coal is well exposed along the railroad grade at the east portal of the B. & O. tunnel at Tunnelton, and its thickness and position in the measures here are exhibited in the section for Tunnelton Tunnel, page 153.

In the northeast edge of the same district, the following section is reported by Hennen along the M. & K. R. R. grade, $\frac{3}{4}$ mile northeast of Caddell:

	Ft.	In.
Sandstone, flaggy and shaly.....	5	0
Shale, sandy	2	0
Coal, slaty.....0' 5" }		
Shale, dark, sandy...2 1 }		
Coal, slaty.....0 8 }		
Slate, black, coaly...1 0 }		
Fire clay shale to railroad grade.....	15	0
(Elevation of coal, 1260' A. T., aneroid).		

From the foregoing data on the Lower Freeport coal, it is evident that the bed attains its best development in Grant and Pleasant districts and is not of much economic importance in other portions of the county.

The Lower Freeport Limestone.

At 3 to 10 feet below the last coal described belongs the well-known Lower Freeport limestone which like the Upper Freeport ledge—30 to 40 feet higher in the measures—has been quarried quite extensively by farmers of Preston for agricul-

tural purposes, and in this county it is evidently a fresh or brackish water deposit, as the only fossils it carries are minute *spiroribis* forms. This stratum is generally dark gray in color and made up of layers with included limy gray shale, the whole sometimes attaining a thickness of 15 to 20 feet. Its relative position in the rock column is exhibited in the Brandonville section, page 80.

In the northern edge of Grant district, Hennen collected a sample for analysis and measured the following section at the Chas. Spindler quarry on the south hillside of Sandy creek, $2\frac{1}{2}$ miles N 60° W of Clifton Mills:

		Ft.	In.
1.	Sandstone, massive, Upper Freeport...	10	0
2.	Shale, dark, sandy.....	2	0
3.	Slate, black.....	1	6
4.	Coal 0' 2 "	Lower Freeport Coal	10½
5.	Slate, black...0 1		
6.	Coal 0 7		
7.	Slate, black...0 3		
8.	Shale, dark, sandy 3 0		
9.	Slate, black...0 4		
10.	Coal, soft.....0 9		
11.	Bone 0 0½		
12.	Coal 0 6		
13.	Slate, black...0 1½		
14.	Coal, soft....1 4	Lower Freeport Limestone ...	5
15.	Slate, black...0 1		
16.	Coal, bony....0 6		
17.	Slate, dark gray 0 0½		
18.	Coal 0 1		
19.	Fire clay.....	7	0
20.	Limestone, dark gray 1' 5"	Lower Freeport Limestone ...	5
21.	Shale, gray, and limy....1 0		
22.	Limestone, dark gray and hard, with spiroribis fossils 3 0		
24.	Concealed		
(Elevation of limestone, 1635' A. T., aneroid).			

(Elevation of limestone, 1635' A. T., aneroid).

The **composition** of the sample from Nos. 20 and 22 of section as reported under Laboratory No. 794H by Messrs. Hite and Krak is found under No. 1 in the table next below:

Lower Freeport Limestone Analyses, Preston County.

	No. 1	No. 2	No. 3	No. 4	Aver. 4 Samp.
	Per ct	Per ct	Per ct	Per ct	Per ct
Silica (Si O_2).....	6.31	5.40	12.36	5.41	7.37
Ferrie Iron (Fe_2O_3).....	2.41	2.46	2.14	2.34	2.34
Alumina (Al_2O_3).....	2.05	2.54	3.40	1.03	2.25
Calcium Carbonate (Ca CO_3).....	86.11	84.40	78.22	83.11	82.98
Magnesium Carbonate (Mg CO_3)....	1.76	2.20	1.51	5.43	2.72
Phosphoric Acid (P_2O_5).....	0.13	0.22	0.52	0.10	0.24
Loss on ignition.....	1.80	2.63	1.32	2.71	2.12
Totals	100.57	99.85	99.47	100.13	100.02

No. 1—From Chas. Spindler quarry, $2\frac{1}{2}$ miles N 60° W of Clifton Mills, see above section.

No. 2—From J. Guthrie quarry, $1\frac{1}{2}$ miles N 15° W of Brandonville, see page 160.

No. 3—From D. W. Glover quarry, 2 miles southwest of Five Forks, see page 168.

No. 4—From Joshua Fike, 1 mile SE of "Evans Hill," see page 168.

The above analyses show this ledge to have a composition very similar to that of the Upper Freeport limestone, and, like the latter, is well adapted to burning into agricultural lime, and should furnish an abundance of fair road material in the eastern half of Grant district.

It is also this ledge that is quarried in the hill immediately east of Clifton Mills at an elevation of 1690' A. T., aneroid, on the land of Samuel Harader, where Hennen reports 5 feet of dark gray limestone visible, 5 feet below an old digging in the Lower Freeport coal.

Northward it has also been quarried quite extensively along the public highway at the W. Va.-Penna. State line, 0.3 mile west of the latter's intersection with Little Sandy creek, where Hennen reports the following section:

	Ft.	In.
Coal, with partings, Lower Freeport.....	4	0
Sandstone, shaly.....	10	0
Shale	4	0
Limestone, gray and hard, Lower Freeport..	5	0
(Elevation of limestone, 1645' A. T., aneroid).		

Along the west hillside of Big Sandy, 1.5 miles N. 15° W. of Brandonville, this limestone is mined for agricultural pur-

poses on the land of **Jeremiah Guthrie**, where a sample for analysis was collected and the section, given on a preceding page under the discussion of the Lower Freeport coal, was measured by Hennen. The **composition** of the sample as reported by Messrs. Hite and Krak under Laboratory No. 780H is found under **No. 2** in the above table of analyses.

There is an old abandoned mine on this ledge on the east hillside of Big Sandy creek at Bruceton Mills, where it comes 55 feet by hand-level above the base of an opening in the Upper Kittanning coal, the latter vein being the same as that mined near the east end of the bridge over Sandy at this place.

A sample for analysis was collected and the following section measured by Reger at the **D. W. Glover quarry** on the Lower Freeport limestone in the northeastern portion of Grant district, 2 miles southwest of Five Forks:

	Ft.	In.
Shale, dark.....	2	0
Limestone, dark gray, hard, slightly carbonaceous	5	0

The **composition** of the sample as reported by Messrs. Hite and Krak under Laboratory No. 789H is found under **No. 3** in the foregoing table of analyses.

In the extreme eastern edge of Grant district, this stratum has been quarried quite extensively by farmers along the W. Va.-Md. State line for agricultural purposes where it attains the best development observed in the county. The sections given on pages 161 and 162 under the description of the Lower Freeport coal for this region at the Truman Frazee and Frank Humberson limestone quarries show the quarry rock as belonging in the Allegheny series and not in the Conemaugh as placed by Martin² of the Md. Geological Survey. A sample for analysis was collected and the following section measured at the **Joshua Fike quarry**, $\frac{1}{4}$ mile west of the W. Va.-Md. line and 0.9 mile S 15° E of "Evans Hill":

		Ft.	In
1. Shale dark, sandy.....		5	0
2. Coal, bony.....0' 6"	} Lower Freeport	1	11
3. Slate black, coaly 0 10			
4. Coal 0 7			

²Geologic Map accompanying Garrett County Rept., Md., Geol. Survey; 1902.

		Ft.	In.
5. Fire clay, dark.....		3	0
6. Limestone, silicious, shaly..2' 0"	} Lower Freeport Limestone	9	0
7. Shale, limy,.....2 0			
8. Limestone, massive, dark gray, with spiroribis fossils 5 0			

(Elevation of quarry, 2460' A. T., aneroid).

The **composition** of the sample from No. 8 only of section as reported by Messrs. Hite and Krak under Laboratory No. 792H is found under No. 4 in the foregoing table of limestone analyses.

One mile northwestward it is this limestone that is quarried near the summit of Evans Hill on the land of Jos. Guthrie at an elevation of 2470' A. T., aneroid.

In the same district it was once quarried for agricultural purposes, according to Reger, on the land of Amos Moyers, one mile west of Hazelton, where it is reported 5 feet thick, 2 feet below the Lower Freeport coal.

The Lower Freeport Sandstone.

The well known Lower Freeport sandstone attains a fine development in Preston, where it belongs 5 to 15 feet below the coal of the same name and ranges in thickness from 30 to 100 feet. It is usually grayish white, very hard, micaceous, often pebbly and massive, splitting unevenly; and for that reason is not adapted to quarrying for building stone. Its crop is confined closely to the same region as that outlined on Map II for the Upper Kittanning coal. As at its type locality in Pennsylvania, it is generally split into two divisions—upper and lower—by the Upper Kittanning coal and fire clay, the Johnstown (cement) limestone and Hardman fire clay. The thickness and relative position of these divisions in the rock column are exhibited in the sections in Chapter IV for Rockville, Rockville 1.8 miles NW, Rockville 1.5 miles NE, Brandonville, Rockville 2 miles SW and Rowlesburg; and in Coal Test Borings Nos. 63, 65, 70 and 74B in Chapter XII.

In Grant and Pleasant districts this stratum frequently

forms high cliffs along the valley walls of Big Sandy creek, and southeastward in the extreme southern point of the latter area forms the shoals in Cheat river, just below the mouth of Muddy creek. Along the southwest edge of Valley district the upper division of this sandstone forms the cliffs along the public road, 1 mile northeast of Gladesville. No quarries were observed on this ledge.

The Upper Kittanning Coal.

The well known Upper Kittanning coal, belonging 80 to 110 feet below the Upper Freeport coal and 50 to 75 feet above the Lower Kittanning bed, is very irregular in its distribution, often being absent entirely and when present seldom exceeding 4 feet in thickness. It is always double and sometimes multiple-bedded, invariably carrying a thin parting slate 8 to 12 inches above its base and frequently a black, lustrous, cannel slate immediately over the top. The following is a type section of the bed where it attains its normal development:

		Ft.	In.
1. Sandstone, massive, Lower Freeport,			
upper division.....			..
2. Slate, black, cannel...0' 6"			
3. Coal, soft.....2 6	}	4	0
4. Slate, dark gray.....0 2			
5. Coal, soft.....0 10			

Nos. 3 and 5 of the section resemble the "main bench" and "mining ply", respectively, of the Upper Freeport vein, and for this reason the coal is frequently mistaken for that bed. Its thickness and relative position in the rock column are exhibited in the general sections in Chapter IV and Bore Holes Nos. 37, 42, 65, 70, and 74B, and its crop is outlined in detail on Map II.

The distribution, character, composition and calorific value of this coal will be discussed fully in Chapter XII along with which will be given an estimate of the probable minable area and tonnage by magisterial districts.

The Upper Kittanning Fire Clay.

A very persistent fire clay, known as the Upper Kittanning², belongs immediately under the last coal described. In Chapter IV it is noted in the sections for Kanawha Creek and Herring, and also in Bore Holes Nos. 37 and 74B. Its crop follows closely the same area as that outlined for the coal of the same name. The character and composition of this clay will be further described in Chapter XIII.

The Johnstown Cement Limestone.

The well known Johnstown limestone is fairly persistent in Preston county where it belongs 5 to 10 feet below the Upper Kittanning coal and ranges from 1 to 5 feet in thickness. Like the Upper and Lower Freeport limestones above, it is evidently a fresh or brackish water deposit, since no marine fossils were observed in the same. Its crop should follow closely the same area as that outlined on Map II for the Upper Kittanning coal. Its thickness and position in the rock column are exhibited in the section in Chapter IV for Nebo Church and the general section of the Allegheny measures at the beginning of this chapter.

In Grant district, slightly over a mile south of Laurel Church, 2 feet of this ledge, fairly pure, crops at this horizon along the north hillside of Big Sandy creek at an elevation of 1575' A. T., aneroid.

Three and a half miles southwestward in Pleasant district the Johnstown Cement limestone was once quarried for agricultural purposes on the land of F. M. Light, on the north hillside of Cheat river, at an elevation of 1880' A. T., aneroid. 45 feet by hand-level below an old opening in the Lower Freeport coal. In 1912 the quarry had fallen shut so that it was not possible to ascertain the thickness and character of the stratum.

The crop of this ledge is well exposed along the railroad grade in the western edge of Lyon district, 0.9 mile due north of Hardman, where it comes at an elevation of 1160' A. T., aneroid, 3 feet below the Upper Kittanning coal and immedi-

²W. Va. Geol. Survey, Monongalia-Marion-Taylor Rept., p. 344; 1913.

ately over the Hardman flint fire clay. Here it is 6 feet thick, gray, hard and fairly pure, carrying *spiroribis* fossils.

In the same district, 0.6 mile southwest of Independence, this limestone is recorded 5 feet in thickness in Bore Hole No. 66 on Map II, at a depth of 183' 10", 34 feet below the Upper Kittanning coal.

The Hardman Fire Clay.

The Hardman fire clay³ attains a fine development in Preston, having first been named from a commercial mine in this clay, located one mile north of Hardman in this county, where the following section was measured:

Section at the Hardman Clay Mine.

	Ft.	In.
1. Coal, Upper Kittanning.....	3	8
2. Shale	3	0
3. Limestone, gray and hard, <i>spiroribis</i> fossils, Johnstown Cement.....	6	0
4. Fire clay, dark, flinty 12' 6"	17	0
5. Fire clay, plastic 5 0		

(Elevation of clay mine, 1145' A. T., aneroid).

Separate samples were collected here of the plastic and flint clays, the composition and character of which, as well as a discussion of the plant operating the mine will be given under "Clays" in Chapter XIII.

The crop of this bed should follow closely the same area as that outlined on Map II for the Upper Kittanning coal. Bore Hole No. 74B, located 1.2 miles southeast of Manown Station, records 23 feet of good fire clay at this horizon, 25 feet below the Upper Kittanning coal. Bore Hole No. 66, located 0.6 mile southwest of Independence, records 7' 6" of plastic clay at this horizon.

It is apparently this clay that crops along the east hillside of Cheat river, 0.5 mile southeast of St. Joe, at an elevation of 1300' A. T., aneroid, where Reger reports 10 feet of flint clay, 45 feet below the Upper Kittanning coal. The composition of a sample collected here is given in Chapter XIII under "Clays".

³Monongalia-Marion-Taylor Rept., W. Va. Geol. Survey, p. 347; 1913.

The Middle Kittanning Coal.

The Middle Kittanning coal while not of great importance is quite persistent in Preston, a feature unusual in other counties of the State where it is generally overshadowed by the other two Kittannings. Its thickness and relative position in the rock column are exhibited in the sections in Chapter IV for Rockville N, Nebo Church and Newburg, and Bore Holes No. 37, 1 mile east of Masontown; No. 42, 1 mile south of Masontown; No. 48, 2.2 miles S 45° W of the same place; and No. 72, 0.3 mile north of Austen.

In Grant district it is this coal that crops at the foot of the hill road leading due north from Bruceton Mills, at an elevation of 1543' A. T., hand-level, 32 feet below the Upper Kittanning bed which has long been mined here on the opposite side of Sandy creek, where the former is 2 feet thick and is mostly black slate with laminations of coal.

Along the southwest edge of Valley district the following section was measured by Hennen at the crop of this coal at the M. & K. R. R. grade, 0.2 mile south of Kanes Creek station, 30 to 40 feet below the Upper Kittanning bed:

	Ft.	In.
Sandstone, flaggy and broken.....	8	0
Shale, gray.....	0	3
Coal, soft, Middle Kittanning.....	1	1
Shale, gray.....	2	0
Sandstone, massive.....	1	3
Shale to railroad grade.....	5	0

(Elevation of coal, 2030' A. T., aneroid).

The foregoing data show this bed to be too thin and impure to be classed as a minable vein.

The Lower Kittanning Coal.

The well known, multiple-bedded Lower Kittanning coal, although very irregular in some portions of Preston, attains a fine development along the northwest and southeast borders of the county, where, with its parting slates, it ranges in thickness from 4 to 7 feet. The following is a general section of the vein in these regions:

		Ft.	In.
1. Coal, bony and slaty, often cannelly.....	0' 6"		
2. Coal, soft, columnar....	3 0		
3. Slate, gray, with some- times thin coal streak near middle.	1 0	 7	0
4. Coal, soft, columnar, with sometimes 1 to 2" black slate near middle	2 6		

The big shale parting (No. 3 of section) sometimes varies in the same mine from 2 inches to 3 feet. The detailed crop of this bed is approximately outlined on Map II. Its thickness, character and relative position in the measures are exhibited in the sections in Chapter IV for Rockville, Brandonville, Clifton Mills and Newburg; and in the logs of Bore Holes Nos. 37, 42, 48, 63, 65, 70, 84 and 88 on Map II, all of which are published in Chapter XII.

The distribution, character, composition and approximate minable area and available tonnage will be discussed fully in the same chapter.

The Lower Kittanning Fire Clay.

The Lower Kittanning fire clay, belonging immediately below the last coal described, is very persistent in Preston, generally ranging in thickness from 5 to 10 feet and nearly always of a plastic nature. Its crop follows closely the same area as that outlined for the coal of the same name on Map II. In Chapter IV it is noted in the sections for Brandonville and Rowlesburg, and in Chapter XII in the log of Bore Hole No. 72, located 0.2 mile north of Austen, and No. 66, 0.6 mile southwest of Independence.

In Valley district this clay is 10 feet thick where its crop is exposed along the northeast side of the public road, 0.6 mile southeast of Herring, at an elevation of 1095' A. T., aneroid, at which place a sample for analysis was collected by Reger, the composition of which is given under "Clays" in Chapter XIII, wherein a discussion of the character of the clay is given.

The Vanport (Ferriferous) Limestone.

The well known marine fossiliferous and ferriferous Vanport limestone, belonging immediately below the last fire clay described is quite irregular and not present as a marine deposit in the measures of Preston, its presence being observed at only a single point in the county; viz., along the Balt. & Ohio R. R. grade, 0.8 mile northwest of Buckhorn. Its thickness, character and relative position in the rock column are exhibited in the Rowlesburg section, page 97. No marine fossils were observed, and it is evidently a fresh or brackish water deposit, like the Freeport and Johnstown limestones above.

The Clarion Sandstone.

The Clarion sandstone, belonging immediately below the last limestone described and above the Clarion coal, attains a fine development in Preston, being grayish white in color, medium grained and ranging in thickness from 20 to 40 feet. Its thickness and position in the measures are exhibited in the sections in Chapter IV for Brandonville, Newburg and Mannheim; and in the log of Bore Hole No. 63, located 1 mile northeast of Independence. In Grant and Pleasant districts it frequently forms high cliffs along the valley wall of Big and Little Sandy creeks. In the extreme western edge of Lyon district it is this stratum that is being quarried extensively for glass sand, $1\frac{1}{4}$ miles north of Hardman, by the Irvington Mineral Company, the composition and character of which are discussed under "Glass Sand" in Chapter XIV. There it underlies the Lower Kittanning coal 10 to 15 feet and comes immediately over a small coal (Clarion).

The Clarion Coal.

The Clarion coal, belonging at the base of the last sandstone described and being the lowest bituminous formation in the Allegheny series of Preston, is very irregular and always multiple-bedded. In portions of the county it is absent entirely from the measures and in other portions attains a fine development, ranging from 3 to 6 feet in thickness. The sections in

Chapter IV for Rockville, Brandonville, Manheim and Rowlesburg; and the logs of Bore Holes Nos. 42, 63, 65, 72 and 84 in Chapter XII exhibit its thickness and stratigraphic position in the rock column. Its distribution, thickness, composition and approximate minable area and available tonnage are discussed fully in the last mentioned chapter.

The Clarion Fire Clay.

The Clarion fire clay of western Pennsylvania, belonging immediately below the the last coal described and from a few inches to 25 feet above the base of the Allegheny series, is generally represented in Preston county by impure clay and sandy shale when the coal of the same name does not rest immediately upon the Homewood sandstone; hence, it is not of much economic importance in the territory of this report.



Photo by E. E. Knight
Series on Briery Mountain in background
Series in the foreground and Pottsville

CHAPTER VIII.

STRATIGRAPHY—THE POTTSVILLE SERIES.

The Pottsville series or basal formation of the Pennsylvanian immediately underlies the Allegheny, and in Preston county retains in only a slight degree the extreme conglomeratic character that gives the series its prominence at the type locality near Pottsville, Pennsylvania. The following general section compiled from observations on a large number of exposures in the territory of this report, fairly represents the Pottsville therein:

General Section of the Pottsville Series for Preston County.

	Thickness Feet.	Total Feet.
Sandstone, massive, grayish white, with occasional quartz pebbles, Homewood....	50	50
Coal, Tionesta	1	51
Fire clay, flinty, Mt. Savage.....	10	61
Shale, sandy, with fire clay, iron ore and limestone nodules.....	23	84
Coal, Upper Mercer	1	85
Shale, sandy.....	29	114
Coal, Lower Mercer	1	115
Shale, sandy.....	10	125
Sandstone, hard, white, massive. pebbly, Upper Connoquenessing.....	75	200
Coal, Quakertown	2	202
Shale, sandy.....	27	229
Limestone, ferruginous.....	1	230
Sandstone, hard, white, massive, sometimes pebbly, Lower Connoquenessing.....	40	270
Shale, sandy and ferriferous, with streaks of coal.....	4	274
Coal, Sharon	1	275
Shale, sandy, with iron ore nuggets.....	15	290
Sandstone, massive, white, pebbly, Sharon..	40	330

No evidence of animal life either of marine or fresh water origin was observed in these measures, but fossil plants occur throughout the series. The succession and character of the

Pottsville formations are exhibited in the several general sections published in Chapter IV.

DESCRIPTION OF POTTSVILLE FORMATIONS.

The Homewood Sandstone.

The Homewood sandstone, belonging at the top of the Pottsville, attains its usual development as exhibited elsewhere in northern West Virginia and ranges in thickness from 40 to 60 feet. It is generally light gray in color, medium grained and hard, often weathering white on exposure. Many fossil remains of *Lepidodendra* and *Sigillaria* are preserved in this stratum, but in only a few instances were quartz pebbles observed therein. Its crop necessarily follows the boundary line between the Allegheny and Pottsville series as shown on Map II. Its thickness, character and stratigraphic relation are exhibited in the sections in Chapter IV for Rockville, Nebo Church, Beaverhole, Newburg, Manheim and Rowlesburg.

Along with the Connoquenessings and Sharon, below, this sandstone forms great cliffs and steep bluffs around the hill-sides. It is a prominent feature along the crest of Chestnut Ridge in the northwest edge of Preston; along the valley walls of Cheat river, Big and Little Sandy creeks; and along the eastern slope of Briery Mountain.

The Tionesta Coal.

The Tionesta coal, belonging at the base of the Homewood sandstone, was observed at several points in Preston county, but as in other portions of northern West Virginia to the west, the bed does not attain minable thickness and is only of scientific interest. Its crop should follow closely the area outlined above for the last sandstone described. The several sections in Chapter IV for Rockville and for Nebo Church, Newburg and Rowlesburg exhibit its thickness and relative position in the rock column.

The Mt. Savage Fire Clay.

The well known Mt. Savage fire clay, belonging immediately under the last coal described at its type locality in Somerset county, Pennsylvania, attains a fair development in the territory of this report, at some points ranging in thickness from 5 to 10 feet. Its crop should follow closely the area outlined above for the Homewood sandstone. Its thickness and relative stratigraphic position are exhibited in the sections in Chapter IV for Rockville, Brandonville and Manheim; and in Chapter XII in the logs of Bore Hole No. 17, one mile northeast of Rockville, and No. 19 in the same region.

The distribution and the character and composition of this clay as revealed from the analysis of two samples will be discussed under "Clays" in Chapter XIII.

The **Hammond Fire Clay**¹ of Marion county, belonging a few feet below the last clay described and directly over the Upper Mercer coal, was not definitely recognized in the territory of this report.

The Upper Mercer Coal.

The Upper Mercer coal, belonging 25 to 40 feet below the Homewood sandstone, like the Tionesta bed above described, does not attain minable dimensions in Preston, but it is fairly persistent and of considerable aid in correlating other Pottsville formations in the county. It is frequently double-bedded and seldom exceeds 2 feet in thickness. The sections in Chapter IV for Rockville, Nebo Church, Newburg and Rowlesburg; and the logs in Chapter XII of Bore Hole No. 19, 1 mile northeast of Rockville; No. 84, six-tenths mile southwest of Corinth; and No. 86, 1.6 miles northeast of Hutton, exhibit its thickness and stratigraphic relation to other rocks in the series.

The **Lower Mercer coal**, belonging a few feet below the last bed described, is quite thin and of no economic importance, having been definitely recognized at only one point in the county as noted in the Rowlesburg section, page 97.

¹Monongalia-Marion-Taylor Rept., W. Va. Geol. Survey. pp. 269-270; 1913.

The Upper Connoquenessing Sandstone.

The well known Upper Connoquenessing sandstone, belonging 125 to 140 feet below the top of the Pottsville series and immediately above the Quakertown coal, is the most widely persistent and characteristic stratum of these measures in Preston. It is grayish white in color, very hard, with large angular quartz pebbles scattered throughout its mass, abounding in plant fossils of the same general type as the Homewood and ranging in thickness from 50 to 100. It usually forms high, bold cliffs around the hillsides where it comes to the surface, and is largely responsible for the rough topography of the Pottsville measures in this county.

The thickness, character and relative position of this stratum in the rock column are exhibited in the sections in Chapter IV for Rockville, Nebo Church, Beaverhole, Newburg and Rowlesburg; and in Chapter XII in the log of Bore Hole No. 84, six-tenths mile southwest of Corinth. Its crop is confined to the region along the crest of the Chestnut Ridge anticline; along the valley walls of Big Sandy creek below Rockville; along both slopes and around the nose of the Briery Mountain anticline; and in the hills northeastward from Aurora to the Maryland line along both flanks of the Mt. Carmel syncline. In Grant district it is this sandstone that caps the summit of Mitchell Knob in the extreme northwestern corner of the county, where it is almost 100 feet in thickness and quite pebbly. Southwestward along the Preston-Monongalia line to and beyond Cheat river it forms the backbone of Chestnut Ridge and preserves about the same thickness and character.

It is this stratum that crops along Big Sandy creek at Rockville and forms cliffs close along the latter stream for 2 miles below and makes the Upper Falls, 1.4 miles northwest of the latter point. This sandstone forms the road bed in the eastern edge of the county, 2.3 miles due north of Feik Hill, where it is grayish white in color and very pebbly.

Southward at Holmes station on the Balt. & Ohio Railroad, the Upper Connoquenessing is being quarried quite extensively for glass sand and sand for cement purposes by the White Rock Sand Co. The composition and character of the sand from this quarry are discussed under "Glass Sand" in

Chapter XIV, along with the discussion of another sample from the same ledge at a point 1.5 miles northward from Brookside.

The Quakertown Coal.

The Quakertown coal, belonging immediately at the base of the last sandstone described, is fairly persistent in Preston and attains fair development in some portions of the county, ranging in thickness from 10 to 33 inches. It is generally soft and double-bedded and attains minable thickness over a small area in the southeast corner of Pleasant district along the crest of the Briery Mountain anticline. Its thickness and stratigraphic position are exhibited in the sections in Chapter IV for Rockville, Manheim and Rowlesburg; and in Chapter XII in the log of Bore Hole No. 84, six-tenths mile southwest of Corinth.

In the northwest edge of Pleasant district the following section was measured at the crop of this vein on the south of Big Sandy creek at Rockville:

		Ft.	In.
Sandstone, massive, Upper Connoquenessing		135	0
Coal, good.....0' 4" }	Quakertown	0	11
Coal, cannell.....0 7 }			
Slate, black.....				0	4
Concealed and sandy shale to creek.....		10	0

Reger measured the following section and collected a sample for analysis at the crop of this coal at the foot of the Upper Falls of Big Sandy, 1¼ miles northwest of Rockville:

	Ft.	In.
Sandstone. Homewood, making steep hill, partly concealed.....	35	0
Concealed	10	0
Coal, Lower Mercer.....	0	6
Shales and concealed.....	5	0
Sandstone, Upper Connoquenessing.....	25	0
Slate, black.....	4	0
Coal, Quakertown	0	5
Slate, black to creek bed.....	5	0

The composition of the sample as reported by Messrs. Hite and Krak is given under **No. 87** in the table of coal analyses at the end of Chapter XII. The results show the coal to be mostly slate and very impure.

In the southeastern corner of the same district, a sample for analysis was collected and the following section measured by Reger at a mine in the Quakertown coal, 2 miles N 10° W of the summit of Piney Swamp Knob:

Henry Reckart Mine, No. 88 on Map II.

	Ft.	In.
1. Draw slate.....	..	..
2. Coal, Quakertown.....	2	9
3. Shale, gray.....	..	..

(Elevation of coal, 2460' A. T. aneroid).

The composition of the sample as reported by Messrs. Hite and Krak is given under No. 88 in the table of coal analyses at the end of Chapter XII. The results show a much purer coal than that at the falls of Sandy, mentioned above. The section shows the maximum thickness observed for the bed in the territory of this report. The same vein was once opened 0.9 mile westward from the last locality at an elevation of 2170' A. T., aneroid, but the mine had fallen shut so that no section could be obtained.

In the southeast corner of Portland district, on the north side of the Balt. & Ohio Railroad and 1¼ miles northwest of Corinth, this coal has been prospected on the State Tuberculosis Sanitarium farm, but when visited in 1912 the openings had fallen shut so that a section could not be obtained. The following section, however, was measured by Hennen on an adjoining tract owned by Geo. Rowe in the immediate vicinity of the last mentioned openings:

	Ft.	In.
Shales, sandy and brown.....	5	0
Coal, bony.....0' 3" } Quakertown ...	1	11
Coal, soft.....1 8 }		
Fire clay.....	3	0

(Elevation of coal, 2605' A. T. aneroid).

When the thicker coals of the county approach exhaustion, this vein no doubt can be profitably mined and should furnish quite a large tonnage from the region in the extreme southeast corner of Pleasant and the northeast corner of Portland district, as well as from the area lying along the Mt. Carmel Basin southwestward from the Maryland line to near Aurora.

The Lower Connoquenessing Sandstone.

The Lower Connoquenessing sandstone, belonging below and separated from the last coal described by 10 to 20 feet of shale, is very similar in character to the Upper Connoquenessing, though it is not generally so thick and massive and consequently does not exert as marked an influence on the topography. It seldom exceeds 40 feet in thickness, is grayish white in color and frequently contains quartz pebbles. Its crop should follow closely the same region as that outlined on Map II for the boundary between the Pottsville and Mauch Chunk measures. Its thickness and relative position in the rock column are exhibited in the sections in Chapter IV for Rockville and Newburg.

This stratum is well exposed along the valley walls of Big Sandy creek for over 3 miles above its mouth, and is apparently the same ledge that forms the Lower Falls in the latter stream, 1.3 miles northwest of Rockville. No quarries for glass sand or other purposes were observed on this sandstone in the county.

The Sharon Coal.

The Sharon coal, belonging immediately below the last sandstone described and a few feet above the Sharon Conglomerate, like the Mercer and Tionesta above, is too thin and irregular in Preston to be classed as a minable bed, but it is of scientific interest in that it is the lowest bituminous formation of the Pottsville series in northern West Virginia. Where observed in the county it is a soft gas coal, ranging in thickness from 0 to 25 inches. Its thickness and relative position in the rock column are exhibited in the sections for Manheim and Rowlesburg in Chapter IV. Its crop should follow closely the same area as that outlined above for the Lower Connoquenessing sandstone.

In the extreme western edge of Pleasant district, Reger collected a sample for analysis and measured the following section at a prospect in this coal on the east hillside of Big Sandy creek, 0.9 mile northeast of the mouth of the latter stream:

Gibson Heirs Coal Prospect—No. 89 on Map II.*

			Ft.	In.
1.	Sandstone, massive and flaggy.....		20	0
2.	Coal, soft, good..0' 8" }	Sharon (1175' B.A. T.)	3	1
3.	Shale, dark.....0 10 }			
4.	Coal, hard, good 1 7 }			
5.	Shale dark.....		2	0
6.	Shale red and concealed to Big Sandy creek		175	0

The composition of the sample as reported by Messrs. Hite and Krak under Laboratory No. 745H is given under No. 89 in the table of coal analyses at the end of Chapter XII. The results reveal a fairly pure coal with a low sulphur content, characteristic of the Pottsville beds.

Along the northeast edge of Valley district the Sharon coal is reported 6 inches thick by Reger at an elevation of 1110' A. T., aneroid, where it crops in the hill road leading to the new bridge over Cheat river at the mouth of Big Sandy creek.

In Reno district along the eastern slope of Laurel Ridge, Reger reports 1 foot of coal at this horizon where its crop is exposed in the public road, 1.1 miles southward from Nazareth Church, at an elevation of 2550' A. T., aneroid, 40 feet above the top of the Mauch Chunk series.

Hennen reports the blossom of this coal in the public road in the southeast corner of Portland district, 3 miles southeast of Terra Alta on the Little Laurel run side of the mountain, at an elevation of 2765' A. T., aneroid, and 30 to 40 feet above the base of the Pottsville series.

The Sharon Conglomerate.

The Sharon Conglomerate, the basal member of the Pottsville measures in northern West Virginia and western Pennsylvania, attains fair development in some portions of Preston, while in other areas it appears to be absent entirely. As at its type locality in the latter State, it carries many quartz pebbles, is grayish white and sometimes brown in color and seldom exceeds 50 feet in thickness. It is noted in the sections in Chapter IV for Rockville, Beaverhole, Newburg, Manheim and Rowlesburg. No quarries were observed on this ledge.



PLATE XIII.—Showing distortion of the Chemung strata on western slope of the Briery Mountain Anticline, along B. & O. Ry. grade west of Terra Alta.

Photo by E. E. Knight

CHAPTER IX.

STRATIGRAPHY—MISSISSIPPIAN ROCKS.

The Mississippian, or Lower Carboniferous measures as limited in the Appalachian region of North America include the Mauch Chunk, Greenbrier Limestone and Pocono Sandstone series, and in Preston the whole crops to the surface over a considerable area of the county, ranging in thickness from 950 to 1300 feet. The different divisions will now be discussed in detail.

The Mauch Chunk Series.

The Mauch Chunk series, belonging immediately below the Pottsville, crop to the surface in the territory of this report. The measures contain no characteristic strata upon which to base any subdivisions of the same, being largely made up of thinly bedded green, micaceous sandstones, alternating irregularly with red and green shales, the whole ranging in thickness from 300 to 600 feet.

The crop of the series as outlined on Map II covers four separate or disconnected areas as follows: (1) a narrow belt in the northwest corner of Grant district along the eastern flank of the Chestnut Ridge anticline; (2) a narrow belt along the valley walls of Cheat river from a point one mile below the mouth of Muddy creek northwestward to the Preston-Monongalia county line, and 3 miles up Big Sandy creek; (3) a long, narrow and sinuous belt extending northeastward from near the common corner of Preston, Barbour and Tucker counties, northeastward along the western flank of the Briery Mountain anticline, around the nose of the latter fold at Cranesville and back the eastern flank of the same arch to near Carmel where it passes around and along the eastern slope of the Mt. Carmel Basin; and (4) a narrow belt in the southeast corner of Union district extending along the northwest slope of Backbone Mountain.

The relative position and character of the formations of the Mauch Chunk are exhibited in the sections in Chapter IV

for Rockville, Beaverhole, Newburg, Manheim, Amblersburg and Rowlesburg. Reference thereto will show a marked increase southeastward from the Beaverhole region.

The well known **Maxton oil** sand of the western counties of the State belongs in these measures, but it is rather difficult to determine whether or not the same is represented in Preston. The Beaverhole section, page 86, contains 42 feet of sandstone of the same character as this oil zone at the horizon it should be expected. In the northern point of Kingwood district it is probably this stratum that forms the great cliffs, 100 to 150 feet high, immediately above the Greenbrier limestone, along the west hillside of Cheat river, 0.4 mile southward from the mouth of Laurel run.

The **Little Lime** of the oil well drillers, also a member of this series, is reported in the Rowlesburg section. This formation generally carries marine fossils.

The effect on the topography of the cropping Mauch Chunk measures in Preston is in very marked contrast to that of the Pottsville, in that its hill slopes are generally smooth and much less rugged, and always under cultivation, while but little cultivation is possible in the crop of the Pottsville beds.

The Greenbrier Limestone.

The Greenbrier Limestone, belonging between the overlying Mauch Chunk and the Pocono Sandstone series below, attains fair development in the territory of this report, and is by far the most important member from an economic standpoint of the Mississippian measures. The formation consists of limestone, red and green shale and calcareous sandstone, the whole ranging in thickness from 150 to 200 feet. In the adjoining area of Garrett county, Maryland, Martin¹ has divided the formation into the Upper, Middle and Lower Greenbrier, as follows: the upper calcareous member, 65 to 85 feet thick; the middle sandy and shaly member, 88 to 98 feet thick; and a lower calcareous member, 27 to 46 feet thick. There the upper ledge contains the purest and most valuable limestone, while the lower is more silicious and gradually grades into the Pocono on which it rests with apparent conformity. Although these divisions are not so marked in Preston, yet the bottom

¹G. C. Martin, Garrett Co. Report, Md. Geol. Survey, p. 96; 1902.

layers are generally more sandy and impure than the top.

The crop of the Greenbrier as outlined on Map II covers four distinct or unconnected areas, closely following the same portions of the county as described above for the Mauch Chunk. Its thickness and stratigraphic position are exhibited in the sections in Chapter IV for Beaverhole, Newburg, Amblersburg and Rowlesburg.

Like the overlying Mauch Chunk, this formation in the immediate region of its crop produces a gently sloping topography in marked contrast to the Pottsville above. Its rapid weathering qualities when exposed to the action of running water are undoubtedly responsible for the present location and configuration of the valley of the South branch of Snowy creek, southeastward from Terra Alta.

Aside from the coals it is probably the most valuable economic mineral resource available in the county and should furnish an almost inexhaustible supply for cement purposes and agricultural lime. In the immediate region of its crop it adds greatly to the fertility of the soil, and is already being drawn upon quite extensively by the farmers of Preston to furnish limestone for their kilns.

A discussion of the quarries in and composition of this formation is given under "Limestone" in Chapter XIII.

Marine Fossils.—The Greenbrier Limestone carries an abundance of marine fossils, especially in the upper portion. A systematic collection of the fauna from this stratum for study and classification could not be made in time to publish in this report, but a cursory examination reveals the four following genera of the brachipoda:

Orthis.

Spirifer.

Productus (two species).

Composita (two species).

also crinoid stems and several genera of the pelecypoda, the most conspicuous of which is **Pinna**, according to W. Armstrong Price, Paleontologist of the State Survey.

The Pocono Series.

The Pocono series, immediately underlying the Greenbrier Limestone, is the basal formation of the Mississippian rocks, and ranges in thickness from 450 to 500 feet.

As revealed in the Rowlesburg section, page 97, the series consists largely of massive sandstones separated by limy ledges and layers of dark sandy and limy shale. The sandstones especially in the upper portion are frequently largely conglomeratic with flat quartz pebbles ranging from the size of a pea to that of a hen's egg. The topmost layer is often quite limy, making it quite difficult to determine just where the Greenbrier leaves off and the Pocono begins. The four great oil and gas zones belonging in this series in the western counties of the State; viz., Keener, Big Injun, Squaw and Berea sands, are all represented in the territory of this report, although the latter horizon is not as definitely recognized as the other three. It has been correlated herein as the first sandstone ledge above the highest of the Catskill red beds.

The character, thickness and relative position of these measures in the rock column are exhibited in the sections in Chapter IV for Beaverhole, Newburg, Rowlesburg, Amblersburg and Hardesty. It is also given in the logs of several test well borings for oil and gas, published in Chapter XI of this report.

In Preston the crop of the Pocono series as outlined on Map II follows closely the same areas as outlined above for the Mauch Chunk and Greenbrier Limestone. Like the Pottsville above, these measures exert a marked influence on the topography where they come to the surface, the massive sandstones forming great cliffs along the valley walls of Cheat river and other portions of the county. Owing to the limy character of some of the members the topography is not so rugged away from the gorge of Cheat as that of the Pottsville, and the soils formed from their disintegration are much more fertile.

In Portland and Union districts the slope of the northwest hillside of South branch of Snowy creek and part of North branch of the same stream is formed by the rapidly dipping top member of the Pocono, the junction line of the series and the Greenbrier limestone evidently having always approximately formed the channel of these streams.

The Northwestern Virginia turnpike from a point one mile east of Brookside southwestward to near Dayton is entirely in the upper portion of the Pocono, along which the pebbly character of the formation is finely exposed.

CHAPTER X.

STRATIGRAPHY—DEVONIAN ROCKS.

The Catskill Series.

General Account.—The Catskill beds, belonging immediately below the Pocono, and resting with apparent conformity on the Chemung, constitute the topmost rocks of the Devonian measures in the Appalachian region. Their crop in Preston, as outlined on Map II, is confined to the eastern portion of the county in Portland, Union and Reno districts, and the southeastern point of Kingwood district, in one long sinuous belt from one-fourth to two miles wide, bordering the belt outlined above for the Pocono, and eight other irregular shaped detached areas, 5 of which are located in the western portion of Union district, two, in the eastern part of Reno district, and one, in the southeast corner of the county, one mile northwest of the crest of Backbone Mountain.

Local Features.—In the territory of this report the Catskill series ranges in thickness from 600 to 900 feet, and consists of alternating layers of shales and sandstones, red and green in color, with various shades of red predominating and often beautifully ripple-marked. The rocks are easily recognized in the field, coming as they do between the Pocono and Chemung, since they weather into a brick red soil and are very similar in character to the Mauch Chunk measures. The series contains no characteristic strata on which to base subdivisions, but the upper portion carries more massive sandstones, while in the lower, shales predominate. The latter are both argillaceous and arenaceous, and the sandstones, medium grained, micaceous and often cross-bedded. The thickness, character and relative position of the series are exhibited in the sections in Chapter IV for Hardesty, Madison Run, Newburg and Rowlesburg.

A sample for analysis was collected by Reger on the land

of Scott Felton from 30 feet of the Catskill shales, red in color, but streaked with green, along the east hillside of Cheat river, 1 mile northwest of Rowlesburg, the composition of which is reported by Messrs. Hite and Krak as follows under Laboratory No. 809H:

	Per cent.
Silica (Si O_2).....	62.77
Ferric iron (Fe_2O_3).....	17.26
Alumina (Al_2O_3).....	8.03
Lime (Ca O).....	0.40
Magnesia (Mg O).....	1.16
Sodium (Na_2O).....	0.32
Potassium (K_2O).....	4.54
Titanium (Ti O_2).....	0.70
Phosphoric Acid (P_2O_5).....	0.01
Moisture	1.01
Loss on ignition.....	4.15
Total	100.35

The high percentage of ferric iron readily accounts for the red color. The sample runs too low in alumina and too high in the easily fusible elements to make brick of high refractory qualities.

The crop of the series affects the topography of the region in much the same way as the Mauch Chunk, although having a tendency to make it more rugged, especially the upper members. The soil formed from the weathering of these rocks is quite fertile and generally cultivated, being well adapted to the growth of buckwheat, one of the important crops of the county.

In the western counties of the State the Catskill contains nine important oil and gas zones; viz., Gantz, Fifty-foot, Thirty-foot, Stray, Gordon, Fourth, Fifth or McDonald, Sixth or Bayard and Seventh or Elizabeth sands, but none has proved prolific in the few tests penetrating the same in the territory of this report.

Absence of Fossils.—That red and green strata were deposited in waters that contained little or no marine life during Catskill time is one of the most important distinctions between these measures and the underlying Chemung. The conditions responsible for such a marked change have not as yet been thoroughly worked out. On pages 168-169 of the Garrett County Report of the Maryland Geological Survey, G. C.

Martin gives the following plausible explanation of this change in conditions in an area adjoining Preston county on the east:

"In the first place the waters became unfavorable to marine life as is indicated by the apparent absence of fossils. Furthermore as far as known, the position of the shore did not change, for there is no evidence of an unconformity by overlap such as would result from a marine transgression; or of the transfer of coastal-plain accumulations into the sea, such as would result from a marine recession. The volume of sediment was continued while its character changed, this change consisting in an increase in the amount of thoroughly oxidized material and in a decrease in the amount of fresh and unsorted material.

"The conditions above cited might have come about as the result of the following causes. To begin with, the region bordering the coast having been reduced by subaerial erosion to a low lying plain, over which all coarser river sediments were spread, only the finer sediments reached the sea. At the same time increased activity of erosion at a distance from the shore, due either to an elevation which did not affect the coast, or to increased precipitation, swelled the volume of the rivers, resulting in the transportation to the coastal plain of a large bulk of sediment of which only the more oxidized and finer portions reached the sea. The surface from which this material originally came was deeply disintegrated and was attacked rapidly by the strengthened streams. The result was a large accumulation of coarse material on the coastal plain, and a large influx of fresh water and of fine sediment into the sea. As a result either of the amount of muddy material and fresh water which was poured into the sea, or of unknown changes in the sea itself, the marine life of the Devonian was destroyed. The waters which extended over the northern Appalachian region must have been shallow and cut off from the main ocean or they could not have been so profoundly affected. The Hampshire (Catskill) epoch was uniform in its conditions from beginning to end, and was probably of long duration."

Sufficient stratigraphic evidence has been collected, however, to show that the Catskill series as herein limited correlates with the Hampshire formation of the last Survey mentioned, and is the equivalent at least in part to the Catskill measures of New York and Pennsylvania.

No plant fossils were observed in these rocks, the apparent absence of which is probably due to the same causes that operated against marine life during this period.

The Chemung Series.

General Account.—The Chemung series are the oldest rocks that crop to the surface in Preston. Their crop as outlined on Map II is confined to the eastern portion of the

county in the same districts as outlined above for the Catskill beds. The Etam, Briery Mountain, Egdon and Deer Park anticlines have all cooperated to keep these measures above drainage over the central portion of Portland district; the major portion of Union; the southeastern point of Kingwood; and the eastern part of Reno.

Local Features.—In this county the Chemung series probably attains a thickness of 1200 feet, consisting of alternating layers of shales and sandstone, yellowish gray, drab, olive green and brown in color. Like the Catskill, the rocks are readily recognized in the field, belonging as they do immediately below the latter series, since they always weather into a yellowish brown soil even in the upper portion where a pale red shale is sometimes observed. The sandstones are generally very hard, fine grained, micaceous and strongly ripple-marked, many carrying an abundance of marine fossil forms. The deeper oil sands of northwestern Pennsylvania belong mostly in the Chemung, but only the **Speechley sand** has thus far proved productive in West Virginia. The series contains no characteristic strata from a physical standpoint on which to base any subdivisions, and unfortunately for this report a detailed investigation of the marine fossil life, on which divisions might be based, has not yet been made in West Virginia.

In January, 1913, the Maryland Geological Survey issued a very exhaustive report on the Middle and Upper Devonian Deposits and Their Contained Life, in which the Jennings formation is divided into four members, based on lithologic and faunal evidence as follows in descending order:

Chemung sandstone member.—*Spirifer disjunctus* fauna.

Parkhead sandstone member.—Recurrent *tropidoleptus carinatus* fauna.

Woodmont shale member.

Genesee black shale member.

In the same report the Chemung is subdivided as follows:

Upper sandstone and shale. *Camarotoechia eximia* zone. In the central part of the area these beds comprise three divisions. Beds of recurrent Jennings type with a marine fauna.

Palaenatina augusta zone.

Red beds of Catskill type.

Beds of Jennings type with marine fauna.



4
PLATE XIV.—Showing distorted condition of the Chemung rocks in B. & O. Ry. cut, $1\frac{1}{4}$ miles N.E. of Rodemer, on west slope of Briery Mountain Anticline.

Photo by E. E. Knight

Upper Chemung conglomerate.
 Middle sandstones and shales.
 Lower Chemung conglomerate. *Tropidoleptus carinatus* zone.
 Lower sandstone and shale. *Dalmanella tioga* zone in west.

This classification, of course, could not be thoroughly carried out in Preston without a very complete investigation of the fossil fauna.

In the region immediately southward from Terra Alta the topmost sandstones of the Chemung differ in a marked degree from those lower down, in that they are grayish white in color, medium grained and quite pebbly.

The thickness and character of the formations composing the series are finely exhibited in the Rowlesburg section, page 97, as well as in the sections for Hardesty, Madison Run and Newburg, published in Chapter IV.

The following short section in the upper portion of the Chemung was measured near the crest of the Briery Mountain anticline along the Balt. & Ohio Railroad, just west of Terra Alta:

	Ft.	In.
Shale, sandy and brown.....	10	0
Sandstone, massive, limy, marine fossils...	5	0
Shale	6	0
Sandstone, flaggy, worm fossils.....	1	0
Shale, bluish gray to railroad grade.....	7	0

The following section was measured along the grade of the same railroad at the middle of the old tunnel—now a cut— $\frac{3}{4}$ mile southwest of the point where the above section was obtained. It is quite interesting in that **streaks of coal** are noted in the formation 58 feet from the top—a forerunner of the great Carboniferous period.

	Thickness Feet.	Total Feet.
Sandstone, olive green, broken.....	30	30
Sandstone, massive, many forms of brachio- pods, pelecypods and crinoids	7	37
Shale, olive green, with thin sandstones....	15	52
Sandstone, massive, olive green.....	1	53
Sandstone, massive, conglomerate.....	1	54
Sandstone, massive.....	4	58
Shale, dark, with coal streaks and iron py- rites, 4".....	0.5	58.5
Sandstone, green shaly and flaggy.....	6	64.5
Shale, olive green.....	8	72.5
Sandstone, massive, green, to railroad grade	15	87.5
Shale, greenish, finely laminated.....	11	98.5
Quartzitic conglomerate, pebbly.....	2	100.5
Shale, bluish gray, pencil.....	8	108.5

A thin streak of coal was observed at another point in these rocks along the Balt. & Ohio Railroad grade, 1.3 miles due west of Terra Alta, where the following section was measured:

	Ft.	In.
Shale, variegated.....	10	0
Shale, dark red silicious, with numerous remains of marine fossils, including shark and fish bones.....	5	0
Sandstone, fine grained.....	7	0
Shale, gray.....	2	0
Coal, bright.....	0	0.1/16
Fire clay shale, gray.....	1	0

Only one member of the Chemung beds has been named in this report; viz., the **Rowlesburg sandstone** that has long been quarried at the town of the same name on the east side of Cheat river, its thickness, character and position in the measures being finely exhibited in the Rowlesburg section, page 97. A more detailed description of this quarry is given under "Building Stone" in Chapter XIV.

The crop of the series affects the topography in much the same manner as the Catskill, although producing steeper hill-sides. The resulting soils are not quite so strong as those produced from the weathering of the latter beds, but are quite fertile and can be much improved by careful cultivation, a discussion of which and their products is given in Chapter XV.

Plant and Marine Life.—The plant life of the Chemung of Preston is very rare when the whole thickness of sediments is considered, yet thin seams of coal with under-clays filled with ramifying rootlets are evidence of the near dawn of Carboniferous time, so that the fossil forms observed are probably the progenitors of the coal measure types.

The marine life of the Chemung series was very prolific during certain periods, while in others it was fairly rare. Fossils are very plentiful in some strata which are separated by thicker layers that are almost barren. In the adjoining region of Maryland, according to C. K. Swartz¹, the Chemung contains a distinct fauna, the most characteristic species of which is **Spirifer disjunctus**. Associated with the latter and scarcely less diagnostic, are several species of the genera **Dalmanella**

¹Md. Geol. Survey, Middle and Upper Devonian, p. 418; 1913.

and **Douvillina**. In Preston the fossils are largely preserved in sandstone and hard arenaceous shale, many of the forms being almost perfect and making the region an ideal locality from which to collect specimens for study and classification.

PART III.

Mineral Resources.

CHAPTER XI.

PETROLEUM AND NATURAL GAS.

Sandstone beds, called **sands**, with the single exception of the Greenbrier Limestone (Big Lime), are the principal oil and gas producing zones in West Virginia. The Big Lime production is confined entirely to the southwestern portion of the State where this horizon has become quite silicious, the oil therefrom being dark and heavy and not grading so high in the market as "sand" oil. The following table, from page 388 of the Monongalia-Marion-Taylor Report of the State Geological Survey, exhibits in descending order the relative position of all the developed oil and gas zones in the State:

The Oil and Gas Horizons of West Virginia.

Carboniferous.	Monongahela Series	Carroll sand (Uniontown).
	Conemaugh Series	{ Minshall (Connellsville). Murphy (Morgantown). Moundsville (Saltsburg). First Cow Run (Little Dunkard) sand (Buffalo). Big Dunkard sand (Mahoning).
	Allegheny Series	{ Burning Springs (Upper Freeport) sand. Gas sand (Lower Freeport).
	Pottsville Series	{ Gas sand of Marion and Monongalia counties (Homewood), Second Cow Run of Ohio. Gas sand of Cairo. Salt sand of Cairo. Cairo?
	Mauch Chunk Red Shale	Maxton, Dawson, Cairo.
	Greenbrier Limestone	"Big Lime;" not generally produc- tive.
Devonian.	Pocono Sandstones	{ Keener sand and Beckett sand of Milton. Big Injun sand. Squaw sand. Berea Grit.
	Catskill Red Beds	{ Gantz sand. Fifty-foot sand. Thirty-foot sand. Stray sand. Gordon sand. Fourth sand. McDonald or Fifth sand. Bayard or Sixth sand. Elizabeth or Seventh sand.
	Chemung and Portage Beds	{ Warren First or Second Tiona, Speechley sand. No well defined oil or gas horizons yet discovered in West Virginia.

With the exception of the Carroll in the Monongahela series, the horizon of all the above sands crops to the surface in Preston, and in the several tests drilled over the county, none has produced either oil or gas in paying quantities. The following table gives not only the sequence therein of these sands but the approximate intervals of each in feet below the

Pittsburg coal and above and below the top of the Upper Freeport coal, the latter being the "key rock" on which the structure contours on Map II are based:

Approximate Intervals From Pittsburgh and Upper Freeport Coals to Top of Oil and Gas Sands.

SANDS.	Pitts- burgh Coal Feet	Upper Free- port Coal Feet (above)	SANDS.	Pitts- burgh Coal Feet	Upper Free- port Coal Feet (below)
Minshall	110	520	Berea	2130	1500
Murphy	220	410	Gantz	2225	1600
First Cow Run..	450	180	Fifty-foot	2275	1650
Big Dunkard....	530	100	Thirty-foot	2325	1700
		(Below)	Stray	2380	1750
Gas	670	70	Gordon	2450	1825
Second Cow Run	860	260	Fourth	2525	1900
Salt	1100	470	Fifth or		
Maxton	1380	750	McDonald	2600	1975
Big Lime.....	1540	910	Sixth or Bayard.	2730	2100
Keener	1680	1050	Seventh or		
Big Injun.....	1730	1100	Elizabeth	2850	2225
Squaw	1980	1350	Rowlesburg (Speechley?)..	3550	2925

Owing to the thickening up of the Carboniferous from west to east, it is quite evident that no specific figures can be given for intervals that will hold good over the entire county.

Description of Sands.

Owing to the fact that no oil or gas has yet been produced in paying quantities in the territory of this report, it has not been deemed necessary to give space herein for a detailed discussion of the above sands. The reader is referred, however, to pages 74-85 inclusive of Vol. I(a), and pages 389-396 of the Monongalia-Marion-Taylor Report of the State Geological Survey for an account of these zones in other parts of West Virginia.

WELL RECORDS AND PROSPECTIVE AREAS.

All the attempts to find oil and gas in paying quantities in Preston thus far have resulted in failure. Eighteen wells have been drilled within the county and these are scattered throughout all the districts except Kingwood and Portland, some of which having penetrated below the horizon of the Speechley. While gathering data in the field for this report, levels were taken on most of the wells and these have been numbered in conjunction with the coal test borings for publication in the text and on Map II, the serial number corresponding in each case. The accompanying table contains the abbreviated logs of 13 wells, as also the elevations of the top of the hole on 6 other borings, the records of which were not obtainable. Under the column headed "Owner", the following abbreviations are used:

Great Elk.....	Great Elk Oil & Gas Company.
Oakland O. & G.....	Oakland Oil & Gas Company.
Philadelphia	Philadelphia Company of West Virginia.
South Penn.....	South Penn Oil Company.

In the elevation column the letter "B" indicates barometric determinations, checked on nearest U. S. G. Survey spirit-level elevations; the letter "L", spirit-levels, both being expressed in feet above tide. Depths and thicknesses are also expressed in feet.

Summarized Record of Tests for Oil.

Map No.	NAME OF WELL.	DISTRICT	OWNER.	Elevation A. T.	Upper Freeport Coal.		Big Injun Sand (Top)	Gordon Sand (Top)	4th Sand (Top)	Total Depth	REMARKS	Map No.
					Depth (Top)	Thickness						
1	H. A. Grimm No. 1	Grant	Wm. McElhee	1915B						550	Dry hole	1
2	H. A. Grimm No. 2	Grant	Jesse Stewart et al.	1915B						1600	2 pockets of oil	2
3	James Collins No. 1	Grant	Jesse Stewart et al.	1851L						800	Sulphur water	3
20	M. A. Wolfe No. 1	Pleasant	Philadelphia	1510B			700		1745	3302	Oil show, Warren SS.	20
34	Steven Tichenal No. 1	Pleasant		1190B						600	Heavy fresh water	34
35	Steven Tichenal No. 1	Pleasant									Oil show	35
46	Isaac Welton No. 1	Valley		1685B						3200	Flow fresh water	46
62	H. Dell Debillier No. 1	Lyon	Great Elk	1190B			800	1500		1830	Oil & gas show, Salt	62
67	Virginia-Md. Coal Corp. No. 1	Lyon	J. M. Guiley	1230B	170	0	1175			3004	Dry	67
69	Wm. H. Shaw No. 1	Lyon	Shaffer et al.	1385B							Dry	69
86	Harred Heirs No. 1	Garrett Co., Md.	Oakland O. & G.	2500B						3200	Dry	86
90	Daniel Sineclair No. 1	Reno	J. G. Wolf	1315B							Dry	90
97	W. A. Watson No. 1	Reno	J. M. Guiley								Dry	97
99	Elb & Saml. Nose No. 1	Reno	J. M. Guiley	2250B						600	Dry	99
100	Pearley Bros.	Reno	Butterfield	1705B							Salt well	100
101	John Funk No. 1	Reno									Dry	101
102	Frank Deacons No. 1	Union	Wolf et al.							800	Salt well	102
102A	Nathan Tanner No. 1	Union	South Penn?							1500	Fresh water	102A
102B	Thos. Beatty No. 1	Union	Geo. Reed							1000	Dry	102B

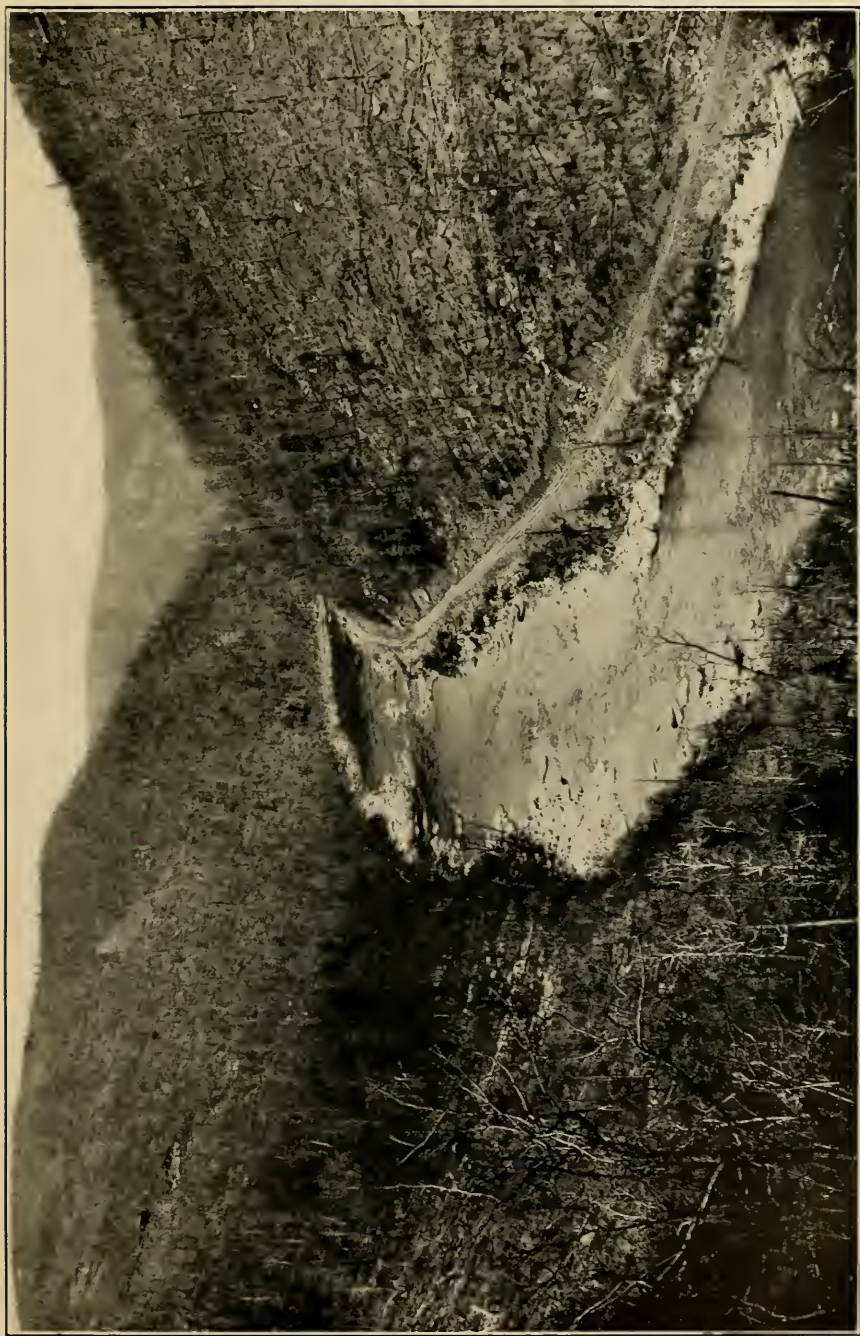


PLATE XV.—Looking down Cheat River gorge near Buckhorn on B. & O. Railway. Valley walls in Mauch Chunk Pottsville and Allegheny rocks.

Photo by E. E. Knight

This table furnishes a means of ready reference as to the name, ownership, and elevation of the several wells, as also the total depth and the depth to well known oil and gas zones. The accurate location of any tabulated well is readily determined from its serial or map number by first glancing at the name in the table opposite the corresponding number and then referring to the index for a further description of the boring, the serial number being published in parentheses along with the heading in the text when the complete log is given.

A discussion of the attempts to find oil and gas and the structural conditions throughout the county will now be taken up by magisterial districts.

Grant District.

Grant district occupies the northern end of Preston county, and adjoins Fayette county, Pa., and Garrett county, Md. A reference to the structure contours on Map II shows its area traversed by four anticlinal folds; viz, Chestnut Ridge, Preston, Five Forks and Briery Mountain; and by three synclinals; viz, Ligonier, Kingwood and Glade Farms. The structural conditions are ideal for the accumulation of oil and gas into commercial pools, yet the results of all the tests thus far drilled in the region eastward from a meridian line through the mouth of Cheat river to the Maryland line, embracing portions of Monongalia, Marion, Taylor, Barbour and Tucker counties, and the whole of Preston, tend to the probability that the conditions leading to the genesis of these valuable hydrocarbons did not prevail, or if so, the intense folding associated with the development of the great Chestnut Ridge and Briery Mountain anticlines may have long ago permitted the escape of these volatile minerals through resulting cracks and fissures.

Since gas pools always accompany rich oil belts, it is strongly advised that future search by the drill in Preston be first confined to the crest of the low anticlinals for gas, which tests, if failures, should demonstrate the futility of seeking for oil down the structural slopes and in the basins.

Only three wells have ever been drilled within the district, all of which were non-productive of either oil or gas. These are all located along the steeply pitching eastern slope of the

Chestnut Ridge anticline, on the waters of Patterson run, in the northwest corner of Grant district, numbered 1, 2 and 3 on Map II.

The **H. A. Grimm No. 1 Well (1)**, located in the northwest corner of Grant district, was drilled in 1859 to a depth of 350 feet, according to data given by Mr. Grimm, where it was stopped on account of the insolvency of the owners. The well starts near the base of the Greenbrier Limestone (Big Lime) and probably penetrated almost through the Big Injun sand. No log was obtained from this boring which resulted in a dry hole.

The **H. A. Grimm No. 2 Well (2)**, located a few feet southwest of No. 1 above mentioned and drilled by Jesse Stewart et al. several years ago, penetrated to a depth of 1600 feet, according to a resident—A. L. Wyatt—who says that two pockets of oil were encountered but did not give the depth of shows. According to Reger, the boring starts only 25 feet above the top of the Pocono or main Big Injun sand and about 1025 feet below the horizon of the Upper Freeport coal, so that it reached entirely through the Catskill series, and consequently below the Seventh or Elizabeth sand, resulting in a non-productive well. No log could be obtained from this boring.

The **James Collins No. 1 Well (3)**, located in the northwest corner of Grant district and drilled by Jesse Stewart et al. about 17 years ago to a depth of 800 feet, resulting in a non-productive well. This boring starts just below the top of the Mauch Chunk series and about 600 feet below the horizon of the Upper Freeport coal, probably penetrating the Berea sand. No log was obtained from this well.

Prospective Oil and Gas Areas, Grant District.—From a structural standpoint the wells above described were poorly selected and in no way test the middle and eastern portions of the district. The only advantage they possessed is that the main oil and gas producing zones of the western counties of the State could be reached at comparatively shallow depths. In harmony with suggestions given, it is herein recommended that future tests in Grant first be completed along the crests of the Preston, Five Forks and Briery Mountain anticlines, where the structure is quite favorable for gas. A good location for gas on the first mentioned arch would be near where the

road crosses Hazel run, $\frac{3}{4}$ mile southwest of Hopewell Church; and another would be 2 miles northeast of the same church, along the run emptying into Big Sandy, 0.9 mile northeastward from the mouth of Hazel. If gas in paying quantity is encountered, then the search could be gradually prosecuted away from the crest down the slopes for the oil, the distance away from which before the latter may be expected depending on whether or not the gas zone is water or non-water bearing. If the latter condition prevails, then the oil will most likely be found down in the Ligonier Basin on the west or the Kingwood Basin on the east. The same line of reasoning applies to the crest of the other two anticlines, a favorable location along the Five Forks fold being on Glade run, $\frac{1}{2}$ mile southwest of Five Forks.

The Briery Mountain arch has flattened northeastward to where it enters Grant from Portland district into a comparatively low fold to what it is southwestward from Cranesville; hence, a location in Grant anywhere along the crest of this anticline would be the most favorable for gas. Of course, if gas does not exist in paying quantity along the crest of these folds in this district, it would be futile to drill down the slopes and in the basins for oil.

Pleasant District.

Pleasant district lies immediately east of Cheat river, west of Maryland and south of Grant district, and, with the exception of the Chestnut Ridge anticline, is traversed in a northeast-southwest direction by the same structural folds as the latter area. As mentioned above under the discussion of Grant district, the presence of either oil or gas in paying quantities is problematical and the risk in drilling great. However, the strata are very much warped, and twisted and the structural conditions ideal for the segregation of any contained oil or gas into commercial pools as a glance at the structure contours on Map II will readily show.

Only three wells have been drilled within the boundaries of the district, and one of these primarily for salt water. All three are located along and near the axis of the Kingwood syncline. The following is a very complete log of one of these borings:

M. A. Wolfe No. 1 Well Record (20).

Pleasant district, 2.1 miles S. 5° W. of Bruceton Mills; authority, the Philadelphia Co. of West Va. Commenced March 6, 1909, and completed May 12, 1909. Elevation, 1540' B-A. T.

	Thickness Feet.	Total Feet.
Allegheny Series (120')		
Unrecorded	18	18
Coal (Lower Kittanning).....	2	20
Lime	40	60
Slate	60	120
Pottsville Series (240')		
Sand, hard (Homewood).....	45	165
Slate	30	195
Sand (water) (Upper Connoquenessing)....	95	290
Coal (Quakertown).....	4	294
Sand (water) (Lower Connoquenessing)....	46	340
Slate	20	360
Mauch Chunk Series (255')		
Lime	40	400
Slate	5	405
Red rock.....	15	420
Lime, hard.....	30	450
Red rock.....	50	500
Lime, gritty.....	55	555
Lime	5	560
Slate, red and white.....	55	615
Greenbrier Limestone (145')		
Lime	65	680
Big Lime.....	80	760
Pocono Sandstone Series (510')		
Big Injun sand (water at 930' and 1080')....	350	1110
Slate and shells.....	70	1180
Berea Grit?.....	50	1230
Slate	40	1270
Catskill Series (910')		
Gantz sand	50	1320
Slate	5	1325
Fifty-foot sand.....	35	1360
Pink rock	5	1365
Slate and shells.....	160	1525
Red rock	5	1530
Stray sand.....	30	1560
Red lime.....	70	1630
Gordon sand.....	35	1665
Red rock.....	40	1705
Fourth sand.....	10	1715
Red rock.....	175	1890
Elizabeth? sand (Fifth).....	10	1900
Red rock and shells.....	80	1980
Slate and shells.....	60	2040
Warren? sand (Sixth or Bayard).....	40	2080
Slate and shells.....	40	2120
Second Warren? sand (pebbles; show of oil) (Seventh or Elizabeth).....	45	2165
Red rock and shells.....	15	2180

	Thickness Feet.	Total Feet.
Chemung Series (1122')		
Unrecorded	455	2635
Cherry Grove? sand.....	10	2645
Slate and shells.....	210	2855
Bradford? sand.....	20	2875
Slate and shells.....	60	2935
Sand	35	2970
Slate and shells.....	30	3000
Slate and shells.....	302	3302
10" casing, 240'; 8"-715'; 6 $\frac{3}{8}$ "-1500'. Dry hole.		

The well starts 130 feet below the horizon of the Upper Freeport Coal and about 760 feet below the Pittsburgh bed. The correlations in parentheses are inserted by the authors. Only a slight show of oil was encountered in what appears to be the Seventh or Elizabeth sand. The Big Injun is the only sand below the Greenbrier Limestone (Big Lime) that carries water in this synclinal basin, where they all should be saturated if they were water bearing. The driller's report shows the regular sands of unusual hardness and closeness, and with no oil or gas in any formation except the slight show above mentioned.

The **Steven Tichenal No. 1 well (34)**, located in the southern point of Pleasant district, 400 to 500 feet northeast of the mouth of Muddy creek, was bored, according to R. B. Frazier of Terra Alta, a driller on the well, during 1881, who reports as follows:

"We drilled 600 feet. Could not case off the water (all fresh water). We got the best oil sand I ever saw at 347 feet. We had 14 feet of oil sand. As the hole was wet all the time we found no oil or gas and the water could not be cased off at all. We found coal at 12 feet—about three feet of it."

This well starts 30 to 40 feet below the crop of the Upper Freeport coal, so that the vein encountered at 12 feet should correlate with the Lower Freeport bed, and the good sand mentioned at 347 feet, with the Second Cow Run. The boring evidently did not quite reach down to the Maxton sand.

The **Steven Tichenal Salt Well (35)**, located 200 yards from the last well discussed, was drilled several years previous to 1881, according to the same Mr. Frazier, who reports as follows:

"About 200 yards from where we drilled, was an old Salt well (35) drilled several years before we went there and had to be abandoned on account of what the natives then called "the Devil Soap," but from all descriptions it was heavy oil, what we were drilling for. They found the oil or whatever it was at 340 or 350 feet. This information I got of good reliable people who boarded the men that drilled the old well, a family by the name of Metheny."

This boring starts near the same horizon as the one last described; hence, the oil show was apparently in the Second Cow Run sand.

Prospective Oil and Gas Areas, Pleasant District.—As mentioned above, the structural conditions are practically the same in this district as in Grant, and the presence of oil or gas in paying quantities just as doubtful. The structure is favorable for gas in that region along the crest of the Preston anticline northeastward from Cheat river for 4 miles, and likewise northeastward from Valley point to the region immediately northwest of Kelley Knob. As in Grant the failure to get gas in paying quantity in these localities would render it futile to search for oil in the district. Gas might be encountered in a test along the crest of the Briery Mountain anticline in Pleasant, but it would be very problematical, especially so as the Pleasant-Portland district line is approached, owing to the intense folding in the region around the nose of this great arch.

Valley District.

Valley district lies immediately southwest of Grant and Pleasant and adjoins Monongalia county, so that its area is traversed in a northeast-southwest direction by three structural folds; viz, the Chestnut Ridge and Preston anticlines and the Ligonier syncline. Practically the same conditions prevail in this district as outlined above for the last two mentioned; hence, the prospects of finding oil or gas in paying quantities are doubtful.

The **Isaac Welton No. 1 well (46)**, located in the Ligonier Basin, 0.4 mile southward from Bretz, and drilled 10 to 12 years ago, is the only test ever sunk within the boundaries of Valley district. No log of this boring could be obtained, but it was a dry hole and is reported to have reached a depth of 3200 feet. As it starts about 25 feet below the Upper Freeport

coal, it penetrated below the Elizabeth or Seventh sand. The well flows a strong stream of fresh water.

Prospective Oil and Gas Areas, Valley District.—The structure is very favorable for a pool of gas in the eastern portion of this district in that territory lying along the crest of the Preston anticline, but for reasons given on preceding pages of this chapter, the financial risk in sinking a boring in this highly folded mountain region would be great. The failure to get gas in paying quantity in a test well located anywhere along or near the axis of this fold southward from coal prospect No. 60 (See Map II) to the Valley-Kingwood district line, would render the chances of getting oil in paying quantity anywhere in the district extremely doubtful.

Lyon District.

Lyon district lies immediately south of Valley district and adjoins Monongalia and Taylor counties. A glance at Map II shows that the major portion of its area lies in the Ligonier and Evansville synclinal basins, a small part along the southwest border being affected by the Hiram anticline. Only three test wells have been drilled in the district, all of which were non-productive. These will now be discussed from north to south across the area.

The following is the record of a boring located in the western edge of Lyon district along the steep eastern slope of the Chestnut Ridge anticline. The well mouth is about 140 feet below the horizon of the Upper Freeport coal; hence, the correlations in parentheses:

Idell Debillier No. 1 Well Record (62).

Lyon district, $\frac{1}{2}$ mile S. E. of Irondale; by the Great Elk Oil & Gas Co.; authority, J. P. Deem, Parkersburg W. Va. Commenced October 24, 1910, and completed December 14, 1910. Elevation 1190' B-A. T.

	Thickness Feet.	Total Feet.
Quick sand.....	32	32
Sandstone, hard and white (Clarion, Home- wood and Upper Connoquenessing).....	268	300
Unrecorded	50	350
Sandstone	25	375

	Thickness Feet.	Total Feet.
Unrecorded	145	520
Sandstone	15	535
Unrecorded	80	615
Sandstone (little oil and gas).....	25	640
Unrecorded	70	710
Big Lime (Greenbrier Limestone).....	90	800
Keener sand	20	820
Big Injun sand	110	930
Red rock and unrecorded.....	240	1170
Sandstone, Berea?.....	20	1190
Unrecorded	30	1220
Sandstone, Gantz?.....	15	1235
Unrecorded	38	1273
Sandstone, Fifty-foot? (Berea)	12	1285
Unrecorded	105	1390
Sandstone, Gordon Stray? (Fifty-foot) (lit- tle gas at 1400') and unrecorded.....	100	1490
Sandstone, Gordon	10	1500
Lime and slate to bottom.....	330	1830

The Virginia-Maryland Coal Corporation No. 1 well (67), located at Newburg at the junction of the axes of the Ligonier and Evansville synclines, was drilled several years ago by the Hon. J. M. Guffey of Pittsburgh, Pa. The detailed log of this well is published on pages 342-343 of Vol. I(a) of the State Survey Reports, the basal 2466 feet also being published in connection with the Newburg section, page 89 of this report. Although the well is ideally located from a structural standpoint for oil in the non-water-bearing sands—representing those below the Big Injun—yet it proved non-productive, not even a showing of either oil or gas is reported by Prof. John F. Carll, who is authority for the record as given in the first mentioned reference.

Mr. C. E. Gustkey of Independence reports a small **seepage of petroleum** out into the workings of the Upper Freeport coal seam at the Newburg shaft mine a few years ago, in sufficient quantity that the State Mine Inspector stopped work in the mine. According to Reger, a bottled sample of this oil, collected by Mr. Gustkey, resembles the Pennsylvania grade of petroleum. This seepage is probably from the Big Dunkard (Mahoning) sand. The log of the well last described fails to report a show of oil at this horizon, but it is possible that such showings were ignored by the drillers at that time.

The Wm. H. Shaw No. 1 well (69), located in the south-

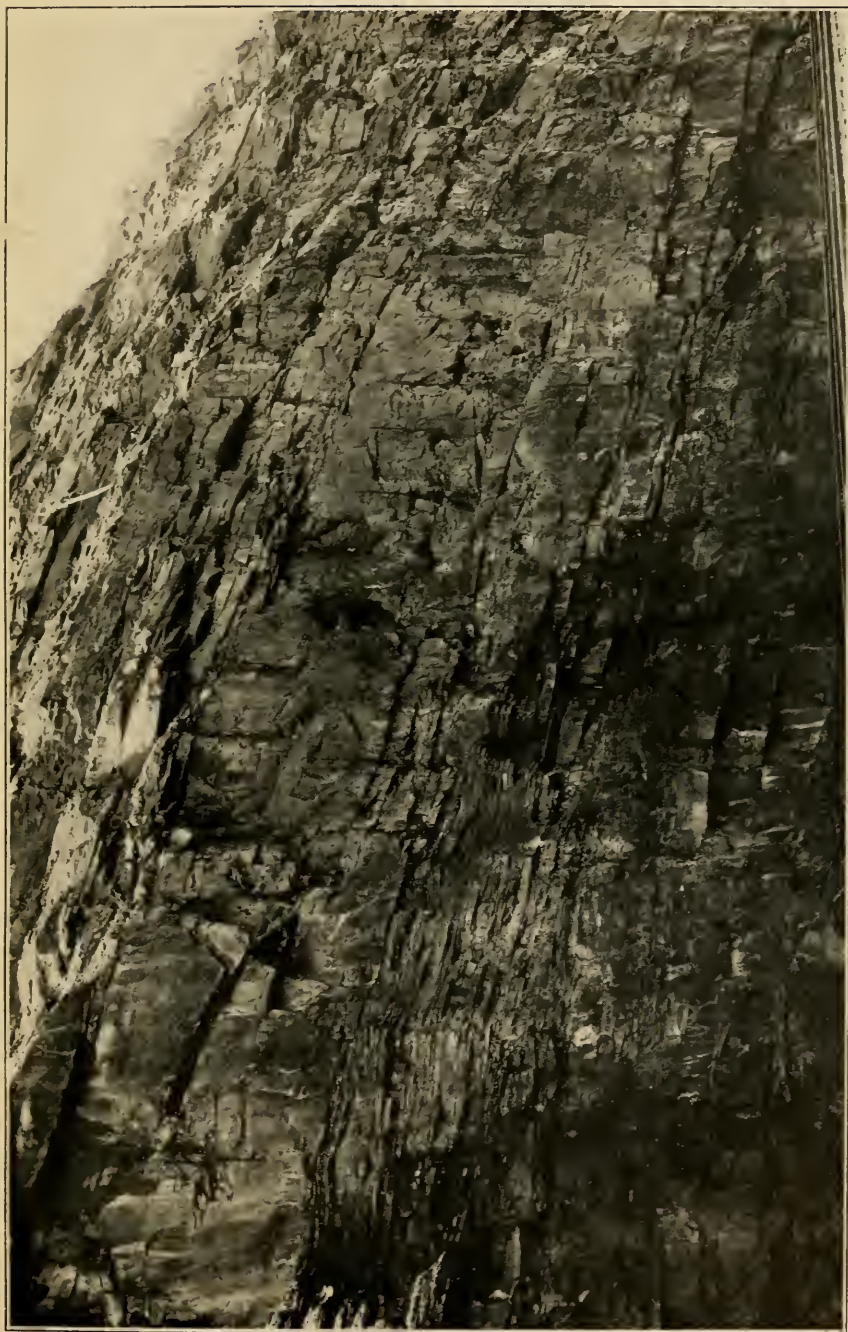


PLATE XVI.—Upper Connoqueussing Sandstone in B. & O. Ry. cut, $2\frac{1}{2}$ miles southeast of Tunnicliffe.
Photo by E. E. Knight

ern edge of Lyon district, one mile due north of Evansville and along the axis of the Evansville Basin, was drilled several years ago and a slight show of gas encountered but no oil, according to W. O. Parriott of Newburg, an interested party. The depth of the well could not be learned nor a copy of the log obtained.

Prospective Oil and Gas Areas, Lyon District.—The results of the three above described test wells render the chances very slim in Lyon district to obtain oil in paying quantity. Should an abundance of gas be found along the crest of the Preston anticline northward from Tunnelton via Howesville, then the prospects for oil along the Ligonier Basin northeastward from Newburg to Browns Mills would appear much brighter.

Kingwood District.

Kingwood district adjoins Valley and Lyon districts, and its area is traversed in a northeast-southwest direction by two structural folds; viz, the Preston anticline and the Kingwood syncline. No test well for oil or gas has ever been drilled therein.

Prospective Oil and Gas Areas, Kingwood District.—The structural conditions are ideal for a great gas field in the territory lying along the crest of the Preston anticline northward from Howesville to where the axis of the fold enters Valley district; especially so in the vicinity of Manown. For reasons mentioned on a preceding page under the discussion of Grant district, the financial risk in drilling even on this arch would be great, since the well known oil sands have a tendency to become close-grained and very hard in this county. In any event, the failure to get gas in paying quantity on the last mentioned fold, would render it almost foolhardy to drill for oil anywhere in the district.

Reno District.

Reno district occupies the southwest corner of Preston and adjoins Lyon and Kingwood districts on the south, so that its area is affected by four structural folds; viz, the Evansville and Hardesty synclines, and the Marquess and Etam anti-

clines. The structural conditions are very favorable in the western half for the segregation of any oil or gas therein into commercial pools, only two non-productive wells having been drilled in this portion, and three in the eastern half. These borings will now be discussed from west to east.

The **Daniel Sinclair No. 1 well (90)**, located in the southwest edge of the district in the Evansville Basin, 0.6 mile northwest of Dent, was drilled by J. G. Wolf of Sistersville, W. Va., to a depth of about 1300 feet, resulting in a dry hole. The boring starts about 100 feet above the horizon of the Upper Freeport coal, and should have penetrated the main division of the Big Injun sand. A log of the well could not be obtained, so it is not known at what depths shows of oil, gas or water, if any, were encountered. This test, in connection with the other two dry holes (69 and 67) in this Basin northward to Newburg, demonstrates the barren nature of the usual productive zones in the territory of this report. The Sinclair well (90), however, does not test the sands below the Big Injun.

The **W. A. Watson No. 1 well (97)**, located in the east edge of Fellowsville, about one-third the way up the eastern slope of the Evansville Basin, was drilled by Hon. J. M. Guffey of Pittsburgh, Pa., several years ago, resulting in a dry hole. The Survey was unable to obtain the log of this boring or any definite information as to whether oil or gas shows were encountered.

The **Eli and Samuel Nose No. 1 well (99)**, located in the southeast border of the district on Little Buffalo creek, 2.2 miles eastward from Sinclair, was drilled during the Civil War to a depth of about 600 feet, according to Howard Gore of Clarksburg, who now owns the land on which the test is situated. The boring starts in the Catskill measures and should have penetrated all the known productive sands of the State. Neither oil nor gas was found in paying quantities, but the well flows a strong stream of fine fresh water. This test is located two miles down the steeply pitching western slope of the Etam anticline, and, from a structural standpoint, was very poorly selected. No log of this well could be obtained.

The **Peasley Bros. No. 1 well (100)**, located on Buffalo creek near Etam, one-third mile east of the axis of the Etam

anticline, was drilled about the year 1830 by a man named Butterfield to a depth of 1700? feet, primarily for salt, according to data given Reger by F. M. Clarkson, a resident of the latter place. No log of this boring was obtained, but the well starts in the Chemung, several hundred feet below the base of the Catskill series and below the known productive sands of the State. The depth (1700') reported at this early date is probably erroneous, since the present day drilling equipment has been developed only during the last 60 years.

The **John Funk No. 1 well (101)**, located on the west bank of Cheat river at the mouth of Buffalo creek and one-half mile down the eastern slope from the crest of the Etam anticline, was drilled 40 to 50 years ago. No log was obtained but the boring starts deep down in the Chemung, 500 to 600 feet below the base of the Catskill series; hence, the chances for getting oil or gas were very remote.

Prospective Oil and Gas Areas, Reno District.—The chances of finding either oil or gas in that portion of Reno east of Laurel Ridge are extremely doubtful for reasons brought out above. West of this Ridge the structure is quite favorable for both, but the same old doubt exists as to whether or not their genesis ever took place in this region. That area lying along the southwest border of the district mostly on the waters of Left fork of Sandy, and westward from the 1300-foot contour of the Upper Freeport coal as outlined on Map II to the Beverly Turnpike, is specially favored structurally for gas and oil; the crest of the structural dome at Marquess, for gas; and that, along the Basin, one mile eastward, for oil. A structural terrace is formed at Tunnelton where the Preston anticline dies down into the steep western slope of the Etam arch, a feature that is frequently associated with oil pools in the western counties, and should a gas field be developed along the crest of the former fold northward from Howesville, a test for oil is specially recommended at the southwest edge of Tunnelton.

Portland District.

Portland district lies immediately northeast of Reno, the most of its area being affected by the intense folding associated with the great Briery Mountain anticline which divides it in

a northeast-southwest direction almost in half. The western edge laps across the axis of the Kingwood Basin slightly at the mouth of Muddy creek and southeast of Kingwood town. No test wells have been drilled within its borders.

The following is the log of a dry hole just across the State line from the southern portion of Portland district. The boring starts, according to Reger, 15 feet below the Bakerstown coal; hence, it should have penetrated below the known productive sands in West Virginia. No oil or gas shows are reported:

Harned Heirs No. 1 Well Record (86).

Garrett County, Md. 1.6 miles N. 50° E. of Hutton. Authority, Oakland Oil and Gas Co. Elevation 2500' B-A. T.

	Thickness Feet.	Total Feet.
Conemaugh Series (180')		
Conductor	10	10
Black slate	20	30
Coal, (Brush Creek)	3	33
White lime	32	65
Slate	15	80
Sand, medium hard	20	100
Slate, black	15	115
Red rock	45	160
Slate, white	20	180
Allegheny Series (250')		
Lime, (Upper Freeport)	5	185
Slate, white	8	193
Gritty limestone	29	222
Black shale (5 ft. coal) (Lower Freeport) ..	5	227
Gray slate	21	248
Lime	37	285
Sand and lime	8	293
Slate, gray	22	315
Black slate	25	340
Lime, dark	40	380
Sand, white, hard	30	410
Shale, dark (6 ft. coal) (Clarion)	10	420
Lime	10	430
Pottsville Series (315')		
Sand, white (Homewood)	28	458
Slate, black (water)	24	482
Lime, black	13	495
White slate	17	512
Black slate (7 ft. coal) (Upper Mercer)	33	545
Gray sand	15	560
Black slate	42	602
Black sand	10	612
Black shale (coal) (Quakertown)	7	619
Sand, hard, white	36	655
Black slate	13	668
Lime, dirty black	14	682

	Thickness Feet.	Total Feet.
Sand and shells.....	2	684
Black shale.....	6	690
Dark sandstone.....	40	730
Dark, limy sandstone.....	15	745
Mauch Chunk Series (665')		
Black slate	23	768
Dark sandstone	40	808
Black shale.....	7	815
Dark gray sandstone.....	7	822
Black slate	13	835
Brown and white slate.....	15	850
Pink slate	5	855
Blue sandstone.....	41	896
Red rock.....	87	983
White slate, lime and shells.....	41	1024
Blue sandstone.....	6	1030
Red rock.....	55	1085
Lime, dark	5	1090
Hard blue sandstone.....	30	1120
Red rock	15	1135
Shale	25	1160
Dark sandstone.....	24	1184
Red rock.....	26	1210
Lime, white, gritty.....	64	1274
Black slate.....	3	1277
Sand	23	1300
Black shale.....	4	1304
Lime, dark.....	22	1326
Red shale	34	1360
Black shale.....	20	1380
Red shelly shale.....	30	1410
Greenbrier Limestone (270')		
Lime, white.....	10	1420
Red slate.....	10	1430
Lime	28	1458
Red shale.....	12	1470
Lime, light.....	8	1478
Lime, black.....	7	1485
Shelly red rock.....	13	1498
Lime, gray.....	30	1528
Red shale.....	4	1532
Sandstone, very hard.....	6	1538
Lime and shells, hard.....	14	1552
Pink sandstone.....	16	1568
Red shale.....	10	1578
Lime, gritty, red.....	17	1595
Red shale and sandstone.....	5	1600
Dark sandstone	15	1615
Blue shale	5	1620
Lime	50	1670
Red shale and lime.....	10	1680
Pocono Series (430')		
Red sandstone (Keener).....	35	1715
Black slate, shale.....	15	1730
Hard gray sandstone (Big Injun).....	40	1770
Shelly black slate.....	5	1775

	Thickness Feet.	Total Feet.
Gray sandstone, very hard (Big Injun).....	60	1835
Black slate.....	15	1850
Dark sandstone.....	10	1860
Black shale	10	1870
White sand	30	1900
Shale	8	1908
Sand and shells.....	27	1935
Black sandstone.....	10	1945
Gray sandstone.....	18	1963
Black slate.....	10	1973
Blue sandstone.....	25	1998
Red sandstone	102	2100
Catskill and Chemung (1100')		
Unrecorded to bottom, about.....	1100	3200
8¼" casing, 759'.		

The record reveals a marked increase in the thickness of the Mauch Chunk over that in the Rowlesburg section, page 97. It does not look hopeful for oil or gas, to say the least, in the Mt. Carmel Basin portion of Portland district.

Prospective Oil and Gas Areas, Portland District.—The chances of finding either oil or gas in paying quantities in the latter area are very remote. The intense folding associated with the formation of the Briery Mountain arch has very probably permitted the escape into the air through resulting cracks and fissures long ago of any oil or gas the strata to attainable depth might have contained. Should a gas field be developed along the crest of the Preston anticline northward from Howesville, then that portion of Portland lying down in the Kingwood Basin is favorable for oil, if the gas horizon be non-water bearing.

Union District.

Union district occupies the southeastern corner of Preston county; hence, its area is traversed in a northeast-southwest direction by two great anticlines; viz, the Briery Mountain and Deer Park, as well as a local arch terminating to the northeast near Egdon; by three synclinal basins; viz, the Mt. Carmel and two local folds passing through Hardesty and Horseshoe run.

Only two wells have been drilled in the district, both of which were dry holes.

The **Nathan Tanner No. 1 well (102A)**, located on the south side of Saltlick creek, 1 mile southeast of Amblersburg.

was drilled by R. B. Frazier of Terra Alta, who gives the following data concerning the same:

"I drilled the N. Tanner well at Amblersburg in 1880 and 1881. We cased off fresh water at 90 feet and drilled 1500 feet; found no coal or lime, nothing but hard shell rock and slate; no salt water, hole perfectly dry all the 1500 feet, no oil or water."

The above boring starts several hundred feet below the base of the Catskill and below the known productive zones of the State, and probably penetrated the Portage beds.

The following is the log of the other well, located 0.6 mile northeastward:

Thomas Beatty No. 1 Well Record (102B).

Union district, 1.4 miles east of Amblersburg. Authority, George Reed. Completed, 1879.

	Thickness Total	
	Feet.	Feet.
Conductor	12	12
Sandstone, fossiliferous	113	125
Slate to bottom.....	875	1000

This boring starts several hundred feet below the base of the Catskill series and below the usual productive sands.

Slight showings of oil have been encountered in the black slates immediately above the Rowlesburg sandstone at the quarry in Rowlesburg, in the western edge of the district, but it is very doubtful if either oil or gas in paying quantities will ever be found within the latter area, since the same intense folding as in Portland district has brought about like conditions and unfavorable structure.

CHAPTER XII.

COAL.

The stratigraphic position, structure and general character of the coals have already been discussed on preceding pages. The purpose of this chapter is to give a more detailed description of the character, chemical composition and calorific value of the apparent minable beds, as well as their probable available area and tonnage.

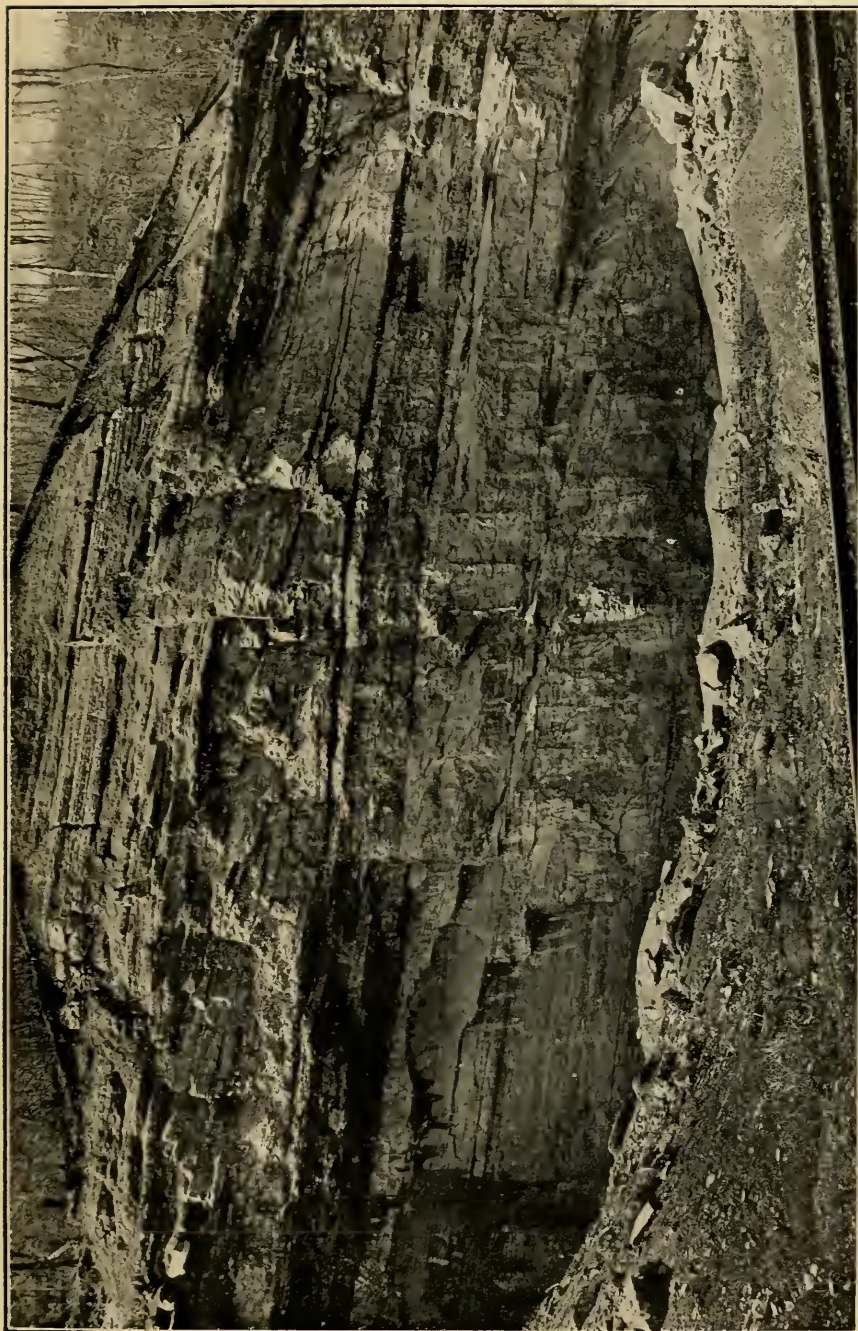
STATISTICS OF COAL PRODUCTION.

In Preston mining on a commercial scale has been confined to five coals; viz, Pittsburgh, Bakerstown, Upper Freeport, Upper Kittanning and Lower Kittanning, the operations being limited to the regions immediately along the Morgantown & Kingwood, the Baltimore & Ohio, W. Va. Northern and Kendall Lumber Company railroads. With the exception of the shafts at Newburg and Independence all the mines are driven either directly on the crop or by short slopes.

The following tables have been compiled from the Annual Report of John Laing, Chief of the Department of Mines of West Virginia, for the year ending June 30th, 1912:

Coal Production of Preston County from 1888 to 1912, Inclusive.

Year	Tons of 2240 lbs.	Year	Tons of 2240 lbs.
1888	147,290	1902	449,528
1889	134,925	1903	574,741
1890	159,320	1904	689,139
1891	134,467	1905	651,122
1892	82,089	1906	827,772
1893	105,618	1907	1,079,692
1894	39,936	1908	874,786
1895	52,385	1909	654,333
1896	116,361	1910	1,033,902
1897	120,211	1911	888,202
1898	169,044	1912	841,801
1899	277,172		
1900	403,610	Total	10,942,160
1901	434,713		



XVII.—Quarry in upper portion of Greenbrier Limestone opposite Manheim; formerly operated by B. & O. R. R. Co. for ballast.

Photo by E. E. Knight

Order of Counties in the Production of Coal, 1897-1912.

Counties.	1897	1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912
Fayette	1	1	1	1	1	1	2	1	2	2	2	2	2	2	2	2
McDowell	2	2	2	2	2	2	1	2	1	1	1	1	1	1	1	1
Marion	3	3	3	3	3	3	3	4	3	4	4	4	4	4	4	4
Kanawha	4	4	4	4	4	4	5	3	4	3	3	3	3	3	3	3
Mercer	5	5	5	6	6	6	6	6	6	6	6	6	6	7	8	8
Harrison	9	9	8	7	5	5	4	5	5	5	5	5	5	5	5	6
Tucker	6	6	7	5	7	7	7	8	8	8	10	10	10	10	10	10
Mingo	8	8	9	9	9	8	7	7	7	7	7	7	9	9	9	9
Mineral	7	7	6	8	8	9	11	11	12	13	14	13	11	13	15	17
Freston	13	11	10	10	10	10	9	10	10	9	9	11	13	11	11	11
Taylor	10	10	11	11	11	11	14	16	16	16	17	17	16	15	14	13
Marshall	11	12	12	12	13	16	13	14	14	15	15	18	19	16	18	16
Randolph .....	.....	.....	.....	14	14	14	12	13	13	12	13	14	14	14	13	14
Barbour	19	19	17	18	12	12	10	9	11	11	11	12	12	12	12	12
Raleigh	16	16	16	19	17	13	15	12	9	10	8	8	8	6	6	5
Putnam	12	13	12	13	15	15	16	15	15	14	18	16	17	17	17	18
Ohio	15	15	14	15	16	17	18	19	21	22	21	21	21	20	20	20
Brooke	17	18	18	20	20	20	23	22	17	17	16	15	15	18	16	15
Mason	14	14	15	16	18	19	19	20	22	21	22	22	22	22	22	25
Grant .....	.....	.....	.....	.....	.....	.....	22	18	19	19	20	20	20	21	21	23
Logan .....	.....	.....	.....	.....	.....	.....	.....	.....	20	18	12	9	7	7	8	7
Monongalia ..	20	17	19	17	19	18	17	17	18	20	19	19	18	19	19	19
Hancock	18	20	20	21	21	21	20	21	24	24	23	25	26	24	27	.....
Clay .....	.....	.....	.....	.....	.....	.....	.....	25	23	23	24	27	30	30	25	24
Nicholas .....	.....	.....	.....	.....	.....	22	24	24	25	25	25	26	27	26	24	29
Lincoln .....	.....	.....	.....	.....	.....	23	21	23	27	26	30	30	25	28	28	.....
Braxton .....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	26	23	23	23	23	22
Wayne .....	.....	.....	.....	.....	.....	.....	.....	.....	26	27	29	29	28	29	32	28
Upshur .....	.....	.....	.....	.....	.....	.....	.....	.....	.....	28	27	24	24	25	29	31
Greenbrier ....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	28	28	29	32	30	27
Lewis .....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	31	31	32	33	33	30
Gilmer .....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	32	32	31	31	31	.....
Wyoming .....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	33	34	34	.....	.....
Boone .....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	33	27	26	21

Production of Coal and Coke in Preston for the Year Ending June 30, 1912, by Mines.

NAME OF COMPANY.	NAME OF MINE.	PRODUCTION OF COAL (Long Tons)			DISTRIBUTION OF COAL (Tons of 2240 Lbs.)				REDUCTION OF COKE (Short Tons)		
		First 6 Months.	Second 6 Months.	Total Coal Produced for Year.	Used in Operation of Mine.	Furnished Local Trade and Tenants.	Used in Coke Ovens.	Quantity Shipped from Mine.	First 6 Months.	Second 6 Months.	Total for Year.
Austen Coal & Coke Co.....	Austen No. 1.....	23,770	50,389	74,159	1,500	770	62,149	9,740	9,480	31,953	41,433
Austen Coal & Coke Co.....	Austen No. 2.....	10,638	25,349	35,987	.....	.....	.....	35,987	.....	.....	B. & O.
Hamilton Coal & Coke Co.....	Newburg.....	23,029	19,378	42,407	3,787	120	.....	38,500	.....	.....	B. & O.
Gorman Coal & Coke Co.....	Gorman No. 3.....	12,120	22,421	34,541	812	223	.....	33,506	.....	.....	B. & O.
Merchants Coal Co.....	Tunnelton.....	98,908	112,884	211,792	4,129	999	.....	206,664	.....	.....	B. & O.
S. H. Jordan.....	Corinth.....	10,579	9,520	20,099	300	705	.....	19,094	.....	.....	B. & O.
Kingwood Coal Co.....	Kingwood.....	15,814	32,946	48,760	858	150	.....	47,752	.....	.....	W. Va. N.
Hite Coal & Coke Co.....	Dixie.....	.....	3,000	3,000	.....	100	.....	2,900	.....	.....	B. & O.
Elkins Coal & Coke Co.....	Bretz No. 2.....	60,647	65,519	126,166	3,022	500	95,081	27,563	37,426	31,513	68,939
Elkins Coal & Coke Co.....	Kingwood No. 4.....	.....	36,893	36,893	721	11	.....	36,161	.....	.....	M. & K.
Elkins Coal & Coke Co.....	Masontown No. 6.....	14,312	49,264	63,576	962	588	.....	62,026	.....	.....	M. & K.
Preston County Coke Co...	Cascade Nos. 1, 2, 3.....	43,173	56,726	99,899	115	816	98,968	.....	35,873	49,786	85,659
Borgman Coal Co.....	Borgman No. 1.....	10,125	15,200	25,325	225	100	.....	25,000	.....	.....	W. Va. N.
Hiorra Coke Co.....	Vulcan.....	.....	5,500	5,500	84	10	.....	5,406	.....	.....	B. & O.
Irona Coal Co.....	Irona No. 2.....	1,360	12,337	13,697	94	2,368	.....	11,235	.....	.....	B. & O.
Totals.....	.....	324,475	517,326	841,801	16,609	7,460	256,198	561,534	82,779	113,252	196,031

Railroad Located on.

DIAMOND DRILL BORINGS.

Over a hundred diamond drill borings have been sunk in Preston to test the thickness and character of the coals and other strata. While gathering data in the field for this report levels were taken on most of the wells and these have been numbered in connection with the oil and gas test borings for publication in the text and on Map II, the serial number corresponding in each instance. The accompanying table contains the abbreviated logs of 53 borings, as also elevations on the well mouth of 48 others, the records of which could not be obtained. Under the column headed "Owner," the following abbreviations are used:

Austen	Austen Coal & Coke Company.
Davis	Davis Coal & Coke Company.
Elkins	Elkins Coal & Coke Company.
Hamilton	Hamilton Coal & Coke Company.
Indian Creek.....	Indian Creek Coal & Coke Company.
Merchants	Merchants Coal Company.
North Preston.....	North Preston Coal Company.
Oakland C. & C.....	Oakland Coal & Coke Company.
Preston Fuel.....	Preston Fuel Company.
W. Va. Dev.....	West Virginia Development Company.

In the elevation column the letter "B" indicates barometric determinations, checked on near by U. S. G. Survey spirit-level elevations; the letter "L," spirit-levels, both being expressed in feet above tide. Depths and thicknesses are also expressed in feet. The explanations following the table of oil and gas wells, page 201, apply, if further information is desired concerning any boring.

Summarized Record of Tests for Coal.—(Continued.)

Map No.	NAME OF FARM	DISTRICT	OWNER	Eleva- tion A. T.	Upper Freepoint Coal		Upper Kittann'g Coal		Lower Kittann'g Coal		Clarion Ctal		Upper Mercer Coal		Total Depth	Map No.
					Depth (Top)	Thick- ness	Depth (Top)	Thick- ness	Depth (Top)	Thick- ness	Depth (Top)	Thick- ness	Depth (Top)	Thick- ness		
57	Wm. Smith.....	Valley	Merchants	1755 B											57	
58	Daniel Zinn.....	Valley	Merchants	1765 B											58	
59	Elza Simms.....	Valley	Merchants	1665 B											59	
60	Wm. Brown Hrs.....	Valley	Merchants	1700 B											60	
61	Lekroy Shackelford.....	Lyon	Merchants	1615 B											61	
63	Calvin Cornwall No. 2.....	Lyon	Preston Fuel.	1310 B											63	
64	E. A. Lyons No. 3.....	Lyon	Preston Fuel.	1398 L											64	
65	J. H. Larew Hrs. No. 1.....	Lyon	Preston Fuel.	1150 B											65	
66	Hamilton C. & C. Co.....	Lyon	Hamilton	1155 B											66	
68	Hamilton C. & C. Co.....	Lyon	Hamilton	1200 B											68	
70	Austen C. & C. Co. No. 1.....	Lyon	Austen	1370 B											70	
71	Austen C. & C. Co. No. 2.....	Lyon	Austen	1395 B											71	
72	Austen C. & C. Co. No. 3.....	Lyon	Austen	1450 B											72	
73	Austen C. & C. Co. No. 5.....	Lyon	Austen	1610 B											73	
73A	Merchants Coal Co.....	Kingwood	Merchants	1740 B											73A	
74	Isaac Foreman No. 13.....	Kingwood	Elkins	2025 B											74	
74A	J. W. Ridenour No. 3.....	Kingwood	Elkins	1950 L											74A	
74B	W. G. Brown No. 12.....	Kingwood	Elkins	2211 L											74B	
74C	W. G. Brown No. 10.....	Kingwood	Elkins	2171 L											74C	
74D	W. G. Brown No. 11.....	Kingwood	Elkins	2238 L											74D	
74E	Garlutz No. 9.....	Kingwood	Elkins	2287 L											74E	
74F	Fawcett No. 8.....	Kingwood	Elkins	2330 L											74F	
74G	John Greaser No. 7.....	Kingwood	Elkins	2195 L											74G	
74H	W. G. Brown.....	Kingwood	Elkins												74H	
74K	G. Dorsey.....	Kingwood	Elkins												74K	
75	Alfred (Rebecca) Carroll No. 14.....	Kingwood	Elkins	1790 B											75	
75A	Elkins C. & C. Co. No. 14.....	Kingwood	Elkins	2098											75A	
76	Robert Shaw.....	Kingwood	Elkins	1610 B											76	
77	Robert Shaw.....	Kingwood	Elkins	1540 B											77	
78	D. O. Feather.....	Portland	Elkins	1829 L											78	
79	Wm. G. Brown.....	Portland	Elkins	1260 B											79	
80	B. P. Whetzell.....	Portland	Elkins	1470 B											80	
81	John O. Whetzell.....	Portland	Elkins	1615 B											81	
82	J. F. Stoor No. 2.....	Portland	J. F. Stoor.	2250 B											82	
83	J. F. Stoor No. 1.....	Portland	J. F. Stoor.	2093 B											83	
84	Oakland C. & C. Co.....	Portland	Oakland C. & C.	2520 B											84	
85	R. C. Seott.....	Garrett Co., Md.		2463 B											85	
87	Wm. Browning.....	Garrett Co., Md.	Austen	2593 B											87	
88	Austen C. & C. Co. No. 4.....	Reno	Austen	1735 B											88	
89	W. S. Jenkins.....	Reno	J. M. Guiley	1335 B											89	
91	Tas. M. Hamilton.....	Reno	J. M. Guiley	1314 L											91	
92	Tas. M. Hamilton.....	Reno	J. M. Guiley	1325 L											92	
93	Tas. M. Hamilton.....	Cove	J. Slaney	1399 L											93	
94	James Lindsay.....	Cove	J. M. Guiley	1365 B											94	
96	Allie Roster.....	Cove	J. M. Guiley	1435 B											96	
96	Mary G. (Stafford) Roster.....	Cove	J. M. Guiley	1435 B											96	
97A	Marcellus Knots.....	Reno	J. M. Guiley	1380 B											97A	
98	Jonas Wolf.....	Reno	J. M. Guiley	1410 B											98	
103	Fred Worthing No. 1.....	Reno	J. M. Guiley	1410 B											103	
104	Wilson No. 3.....	Garrett Co., Md.	Davis C. & C.	2900 B											104	

DETAILED RECORDS OF BORINGS.

Grant District.

A glance at Map II and the foregoing table shows that 15 core test wells have been sunk in Grant district. The Survey was able to obtain the logs of only three, two of which (Nos. 6 and 7) are published in connection with the section for Brandonville, page 80. The other follows herewith:

W. Va. Development Co. Core Test No. 4 (17).

Grant district, 1.0 mile N. 25° E. of Rockville. Authority, W. Va. Development Co. Elevation 1390' L-A. T.

	Thickness Feet.	Total Feet.
Gravel and boulders.....	5.4	5.4
Shale, slightly silicious.....	0.7	6.1
Shale, hard, sandy.....	0.7	6.8
Shale, soft.....	0.5	7.3
Fire clay, soft (Mt. Savage).....	6.8	14.1
Shale, hard.....	1.2	15.3
Fire clay, soft (no core; identified by color of wash).....	3.8	19.1
Shale, hard.....	4.5	23.6
Shale, hard, sandy.....	17.0	40.6
Shale, soft.....	0.5	41.1
Shale and sandstone.....	2.0	43.1
Sandstone, hard.....	3.0	46.1

The above boring starts about 300 feet below horizon of Upper Freeport coal, or approximately 50 feet below the top of the Homewood sandstone.

Pleasant District.

Seventeen coal test borings have been drilled within this district as exhibited on Map II and in the table of bore holes on preceding pages. The eight following records are from bore holes scattered over Pleasant:

W. Va. Development Co. Core Test No. 5 (18).

Pleasant district, 1.0 mile N. 25° E. of Rockville. Authority, W. Va. Development Co. Completed Feb. 18, 1913. Elevation 1406.3' L-A. T.

	Thickness Feet.	Total Feet.
Surface	1.4	1.4
Sandstone, coarse, gray, (Homewood).....	7.6	9.0
Shale, soft, dark.....	2.3	11.3
Shale, black, carbonaceous, (Tionesta coal horizon)	0.5	11.8
Shale, dark, badly broken.....	2.7	14.5
Fire clay, soft (Mt. Savage).....	1.5	16.0
Shale, dark.....	2.4	18.4
Shale, with sandstone partings.....	0.5	18.9
Shale, dark.....	5.1	24.0
Shale, with sandstone nodules.....	1.5	25.5
Shale, dark.....	3.8	29.3
Shale, carbonaceous.....	0.2	29.5
Shale and sandstone, alternating.....	3.5	33.0
Shale, black.....	1.5	34.5
Bone and coal (Upper Mercer coal).....	1.0	35.5
Shale, black.....	1.5	37.0
Shale, gray.....	1.0	38.0
Shale, black, carbonaceous, badly broken...	3.9	41.9
Shale, dark.....	2.1	44.0
Shale, sandy.....	3.0	47.0
Sandstone, fine grained.....	2.0	49.0
Sandstone, coarse grained.....	1.0	50.0

The above well starts 280 to 290 feet below the Upper Freeport coal.

W. Va. Development Co. Core Test No. 6 (19).

Pleasant district, 1.0 mile N. 25° E. of Rockville. Authority, W. Va. Development Co. Completed Feb. 20, 1913. Elevation 1399.5' L-A. T.

	Thickness Feet.	Total Feet.
Sand and boulders	3.5	3.5
Sandstone boulders.....	1.6	5.1
Slate, black (Tionesta coal horizon).....	0.4	5.5
Fire clay (2 feet of core lost) (Mt. Savage)	4.6	10.1
Slate, hard, dark.....	2.5	12.6
Slate, hard, dark, with sandstone nodules..	1.5	14.1
Shale, broken, sandy (2 feet of core lost)..	2.3	16.4
Slate, dark, streaks of sandstone.....	4.5	20.9
Shale, gray.....	3.5	24.4
Slate, dark.....	0.2	24.6
Shale, gray.....	1.9	26.5
Slate, black.....	0.8	27.3
Coal, good (0.2' of core lost) (Upper Mercer)	1.0	28.3

	Thickness Feet.	Total Feet.
Shale, gray (0.8' of core lost).....	1.3	29.6
Shale, soft, gray.....	1.6	31.2
Sandstone, fine grained.....	2.0	33.2
Shale, hard.....	2.7	35.9
Shale, hard, sandy.....	1.7	37.6
Sandstone, coarse.....	2.5	40.1

The above well starts 290 feet below horizon of Upper Freeport coal.

Henry Ringer Core Test No. 8 (27A).

Pleasant district, 1 mile N. E. of Guseman. Authority, Elkins Coal & Coke Co. Completed April 28, 1910.

	Thickness Ft. In.	Total Ft. In.
Surface	3 0	3 0
Sandstone (Mahoning).....	40 0	43 0
Fire clay and shale.....	1 8	44 8
Bone and shale.....0' 6"	} Upper Freeport... Coal	53 7
Coal 2 4		
Binder 0 3		
Coal 1 1		
Binder 1 8		
Coal 2 0		
Bone 1 1	} Coal	55 0
Shale, sandy.....	1 5	55 0

Isaiah Hartman No. 7 (28).

Pleasant district, 1.2 miles south of Guseman. Authority, Elkins Coal & Coke Company. Completed April 22, 1910. Elevation 1880' B.A. T.

	Thickness Ft. In.	Total Ft. In.
Surface	19 0	19 0
Sandstone and shale.....	8 0	27 0
Sandstone	20 0	47 0
Shale, light and sandy.....	16 0	63 0
Shale, dark	22 0	85 0
Bone coal.....	0 1	85 1
Shale dark, sandy.....	12 0	97 1
Sandstone and shale.....	3 5	100 6
Shale, dark	7 0	107 6
Coal (Brush Creek).....	0 4	107 10
Fire clay	3 2	111 0
Shale, sandy	4 0	115 0
Fire clay and shale.....	7 0	122 0
Fire clay	11 0	133 0
Fire clay and shale.....	10 0	143 0
Fire clay (Thornton).....	22 0	165 0
Sandstone (Lower Mahoning).....	27 0	192 0
Soapstone	2 1	194 1



PLATE XVIII.—Showing shaly sandstone member of the Poccono Series in E. & O. Ry. cut south of Mannheim. Photo by E. E. Knight

	Thickness Ft. In.	Total Ft. In.
Bone and coal.....0' 8"	6 0	200 1
Coal 1 8		
Binder 0 1		
Coal 1 2		
Binder 1 4		
Coal 1 1		
Fire clay (Bolivar).....	1 11	202 0

Luther Luraw Core Test No. 6 (29).

Pleasant district, 3.1 miles N. 10° W. of Albright. Authority, Elkins Coal & Coke Co. Completed April 14, 1910. Elevation, 1840' B-A. T.

	Thickness Ft. In.	Total Ft. In.
Surface	8 6	8 6
Shale, broken.....	19 0	27 6
Sandstone and shale.....	20 0	47 6
Shale, dark, sandy.....	25 0	72 6
Bone and slate (Brush Creek coal).....	0 2	72 8
Shale, dark, sandy.....	6 8	79 4
Fire clay	14 0	93 4
Shale, light, sandy.....	7 8	101 0
Lime and shale.....	4 0	105 0
Shale, light.....	3 0	108 0
Fire clay (Thornton).....	10 0	118 0
Sandstone and shale.....	13 0	131 0
Sandstone (Mahoning).....	28 0	159 0
Soapstone	8 7	167 7
Bone and coal.....1' 7"	9 5	177 0
Coal 1 5		
Binder 0 2		
Coal 3 5		
Binder 2 6		
Coal 0 4		

Sarah Bishop Core Test No. 5 (30).

Pleasant district, 3.0 miles N. 15° W. of Albright. Authority, Elkins Coal & Coke Co. Completed April 4, 1910. Elevation 1915' B-A. T.

	Thickness Ft. In.	Total Ft. In.
Surface	25 0	25 0
Limestone	1 0	26 0
Fire clay.....	9 0	35 0
Shale, light	11 0	46 0
Shale, variegated.....	19 0	65 0
Sandstone and shale.....	35 0	100 0
Shale, dark	14 6	114 6
Bone and slate (Brush Creek coal horizon)	0 6	115 0
Shale, dark	4 5	119 5
Coal and slate.....	0 8	120 1

		Thickness Ft. In.	Total Ft. In.
Bone and coal.....1'	8 "	Upper Freeport... Coal	10 1
Slate 0	2		
Bone and coal.....0	7		
Coal 2	5		
Binder 0	1½		
Coal 1	5½		
Binder 0	7		
Coal 1	11		
Binder 0	3		
Coal 0	11		
Fire clay (Bolivar).....		1 2	255 3

Samuel Lee (A. Liston) Coal Test No. 4 (32).

Pleasant district, 2.4 miles N. 5° W. of Albright. Authority, Elkins Coal & Coke Co. Completed March 25, 1910. Elevation 1820' B-A. T.

		Thickness Ft. In.	Total Ft. In.
Surface		8 0	8 0
Slate, black (Ames shale).....		6 2	14 2
Coal 2' 4"	} Harlem	2 6	16 8
Coal and slate.....0 2			
Fire clay		2 4	19 0
Sandstone and shale.....		9 0	28 0
Sandstone, coarse, hard.....		14 0	42 0
Fire clay and shale.....		6 0	48 0
Shale, light.....		20 0	68 0
Fire clay and shale.....		12 0	80 0
Shale, variegated		9 0	89 0
Fire clay and shale.....		10 0	99 0
Slate, black		10 6	109 6
Bone and slate.....0' 7"	} Bakerstown	2 0	111 6
Coal 1 5			
Fire clay		4 0	115 6
Fire clay and lime.....		3 6	119 0
Fire clay		7 0	126 0
Shale, variegated		2 0	128 0
Shale, light		12 0	140 0
Shale, variegated		4 0	144 0
Fire clay and shale.....		12 0	156 0
Sandstone and shale (Buffalo).....		18 0	174 0
Shale, dark, sandy.....		34 0	208 0
Sandstone		7 4	215 4
Coal (Brush Creek).....		0 4	215 8
Fire clay		5 6	221 2
Shale, light		6 10	228 0
Lime and shale.....		4 0	232 0
Shale, light, sandy.....		21 0	253 0
Fire clay (Thornton).....		4 0	257 0
Sandstone and shale.. 5' 0"	} Lower Mahoning.. Sandstone	31 0	283 0
Sandstone			
Sandstone and shale..14 0			
Soapstone (Uffington shale).....		6 6	294 6

		Thickness Ft. In.	Total Ft. In.
Bone and coal.....	1' 6 "		
Coal	0 10		
Binder	0 2		
Coal	2 10½		
*Binder	0 0¼	Upper Freeport... 10 9¾	305 3¾
Coal	0 8		
Binder	0 2		
Coal	1 3		
Binder	0 2		
Coal	0 7		
Shale, sandy		1 8¼	397 0

*NOTE.—Binder was ¼" thick on upper side of core box and 2" thick on lower side.

The above record is quite interesting in that no red color is reported at the horizon of the Pittsburgh Red Shale. It also gives an accurate measurement—227' 10"—from the well known Harlem coal with its overlying Ames shale down to the base of the Conemaugh series. The foregoing bore holes in Pleasant reveal a fine development of the **Thornton fire clay**.

Valley District.

In Valley district the Upper Freeport coal attains a good development, especially along the axis of the Ligonier Basin, where most of the bore holes, representing the 18 following detailed records, were drilled.

Eddy Core Test No. 5 (36).

Valley district. 1.0 mile east of Masontown. Authority, Elkins Coal & Coke Co. Completed, 1907. Elevation, 1682.6' L-A. T.

	Thickness Ft. In.	Total Ft. In.
Surface	3 6	3 6
Sandstone, coarse	20 6	24 0
Shale, light, sandy.....	7 0	31 0
Shale and fire clay.....	5 0	36 0
Shale, dark, sandy.....	17 0	53 0
Sand and shale (Buffalo).....	4 0	57 0
Shale, dark (Brush Creek).....	8 0	65 0
Slate	1 0	66 0
Bone and slate (Brush Creek coal).....	0 6	66 6
Fire clay and shale.....	3 0	69 6
Lime and slate	17 0	86 6
Shale, light, sandy.....	14 0	100 6
Fire clay (Thornton).....	6 6	107 0
Sand rock (Lower Mahoning).....	34 0	141 0

		Thickness	Total
		Ft. In.	Ft. In.
Soapstone		5 0	146 0
Slate and coal.....	0' 8"		
Top coal.....	3 2		
Coal	3 0		
Binder	0 2		
Coal	1 4		
Binder	0 10		
Coal	2 2		
Fire clay (Bolivar).....		1 2	158 6

Upper
Freeport...
Coal

Hartley Coal Test No. 6 (37).

Valley district, 1.0 mile east of Masontown. Authority, Elkins Coal & Coke Co. Elevation, 1817.6' L-A. T.

	Thickness	Total
	Ft. In.	Ft. In.
Surface	36 0	36 0
Limestone and shale.....	36 0	72 0
Sandstone and shale.....	21 0	93 0
Soapstone	1 6	94 6
Fire clay	1 0	95 6
Coal, dirty (Bakerstown).....	2 3	97 9
Fire clay, hard.....	5 3	103 0
Shale, light	8 0	111 0
Sandstone and shale.....	13 0	124 0
Fire clay	7 0	131 0
Shale, light	10 0	141 0
Sandstone	21 0	162 0
Shale, light, sandy.....	6 0	168 0
Sandstone and shale (Buffalo sandstone).	5 0	173 0
Shale, dark, sandy.....	22 0	195 0
Shale, dark	11 6	206 6
Bone coal (Brush Creek).....	0 10	207 4
Fire clay	17 0	224 4
Shale, light	4 8	229 0
Sandstone	8 0	237 0
Shale, light	9 0	246 0
Fire clay (Thornton)	5 0	251 0
Sandstone (Lower Mahoning).....	30 0	281 0
Soapstone and shale.....	7 0	288 0
Soapstone	5 2	293 2
Slate and coal ("rider").....	0 6	293 3
Slate	1 0	294 8
Top coal	3' 3"	
Coal	2 9	
Binder	0 2	
Coal	1 4	
Binder	0 10	
Coal	2 6	
Fire clay (Bolivar)	3 0	308 6
Limestone (Upper Freeport).....	7 0	315 6
Fire clay and shale.....	12 0	327 6
Fire clay	4 6	332 0
Sandstone (Upper Freeport).....	40 0	372 0
Coal, dirty, (Lower Freeport).....	1 6	373 6

Upper
Freeport...
Coal

	Thickness		Total	
	Ft.	In.	Ft.	In.
Fire clay	4	0	377	6
Sandy shale.....	3	6	381	0
Sandstone	9	0	390	0
Sandstone, hard, (Lower Freeport, upper division)	41	0	431	0
Soapstone	3	0	434	0
Sandstone	6	0	440	0
Slate, dark	2	0	442	0
Slate, black	3	0	445	0
Bone coal (Upper Kittanning).....	0	6	445	6
Sandstone and shale.....	20	0	465	6
Sandstone and coal spars (Middle Kittanning coal)	9	0	474	6
Sandstone and shale.....	10	0	484	6
Shale, dark	5	6	490	0
Slate, black	7	0	497	0
Sandstone	1	0	498	0
Fire clay (Lower Kittanning).....	4	0	502	0
Sandstone, variegated, to bottom.....	1	10	503	10

Although the above boring penetrated almost to the base of the Allegheny measures, yet the Upper Freeport is apparently the only minable coal represented. The Kittannings appear to thin away in this district along the Ligonier syncline.

E. M. Hartley Core Test No. 3 (38).

Valley district, 1.1 miles S. 35° E. of Masontown. Authority, Elkins Coal & Coke Co. Elevation 1715.7' L-A. T.

		Thickness		Total	
		Ft.	In.	Ft.	In.
Surface		8	8	8	8
Fire clay		5	2	13	10
Sandstone		11	4	25	2
Fire clay		6	0	31	2
Slate		0	10	32	0
Fire clay		3	1	35	1
Sandstone and con- glomerate 23' 0 "	} (Buffalo .. Sandstone)	40	7½	75	8½
Fire clay.....0 9					
Sandstone and con- glomerate 16 10½					
Sand slate, dark.....		15	8½	91	5
Fire clay		0	8½	92	1½
Sandstone and bone 0' 10½" }	} Brush Creek	1	4½	93	6
Coal, bony.....0 6					
Fire clay		18	8	112	2
Sandstone (Upper Mahoning).....		46	7½	158	9½
Sandstone and fire clay (Thornton).....		10	1½	168	11
Sandstone (Lower Mahoning).....		23	6	192	2
Slate and bone.....		1	1½	193	3½

		Thickness Ft. In.	Total Ft. In.
Bone coal	0' 10½"		
Coal	0 11½		
Bone	0 2½		
Coal	0 3½		
Bone	0 3½		
Coal	1 8		
Sulphur ball	0 0½		
Coal	2 4½		
(Note: 12" of this core lost; it may contain small slate of 0' 2½")			
Slate, big	0 11¼		
Bone	0 1¾		
Coal	0 11½		
Bone	0 1½		
Coal	0 10½		
Fire clay (Bolivar) to bottom	.....	6 2½	103 0½

M. H. Taylor Core Test No. 13 (39).

Valley district, 0.7 mile S. 10° W. of Masontown. Authority, Elkins Coal & Coke Co. Completed, June 28, 1910. Elevation, 1805' L-A. T.

		Thickness Ft. In.	Total Ft. In.
Surface	.....	16 6	16 6
Sandstone	20 ' }		
Sandstone, hard	19½ }	88 0	104 6
Sandstone	48½ }		
Soapstone	.....	4 0	108 6
Fire clay	.....	1 6	110 0
Coal	1' 5 " }		
Binder	0 8½ }		
Coal	1 11½ }	5 3	115 3
Binder	0 1 }		
Coal	1 1 }		
Shale, bastard	.....	0 9	116 0
Shale, sandy, to bottom	.....	1 0	117 0

Elkins Coal & Coke Co. Core Test No. 12 (40).

Valley district, 0.9 mile S. 40° W. of Masontown. Authority, Elkins Coal & Coke Co. Completed, September 23, 1909. Elevation, 1825' B-A. T.

		Thickness Ft. In.	Total Ft. In.
Surface	.....	10 0	10 0
Broken rock	.....	14 0	24 0
Sandstone (Mahoning)	.....	57 0	81 0
Soapstone and sandstone	.....	5 10	86 10
Sandstone	.....	4 2	91 0

			Thickness Ft. In.	Total Ft. In.
Coal	1' 3"	Upper Freeport... Coal	9 6	100 6
Bone coal	0 10½			
Coal	2 7½			
Binder	0 1			
Coal	1 6			
Binder	1 0			
Coal	2 2			
Fire clay (Bolivar) to bottom			1 0	101 6

Elkins Coal & Coke Co. Core Test No. 14 (41).

Valley district, 1.0 mile S. 20° W. of Masontown. Authority, Elkins Coal & Coke Co.

			Thickness Ft. In.	Total Ft. In.
Surface			4 0	4 0
Sandstone (Buffalo)			50 0	54 0
Dark shale			15 0	69 0
Bone coal (Brush Creek)			0 3	69 3
Fire clay			10 9	80 0
Fire clay and shale			6 0	86 0
Light sandy shale			8 0	94 0
Fire clay			4 0	98 0
Sandstone (Mahoning)			43 0	141 0
Sandstone and shale			20 0	161 0
Bone coal	0' 8½"	Upper Freeport... Coal	10 1¾	171 1¾
Coal	0 11			
Bone	1 1			
Coal	2 6			
Binder	0 2			
Coal	1 1½			
Binder	0 0¾			
Coal	0 4½			
Binder	0 11			
Coal	1 3½			
Binder	0 1½			
Coal	0 10½			
Fire clay (Bolivar) to bottom			0 10¼	172 0

Sanford Watson Core Test No. 2 (42).

Valley district, 1.0 mile south of Masontown. Authority, Elkins Coal & Coke Co. Elevation, 1744.6' L-A. T.

		Thickness Ft. In.	Total Ft. In.
Unrecorded		84 3	84 3
Slate, broken		5 9	90 0
Coal, full of sulphur (Brush Creek)		0 9	90 9
Unrecorded		77 9	168 6
Slate		0 6	169 0
Bone, coal and slate (Upper Freeport "rider")		0 11	169 11
Slate and fire clay		5 11	175 10

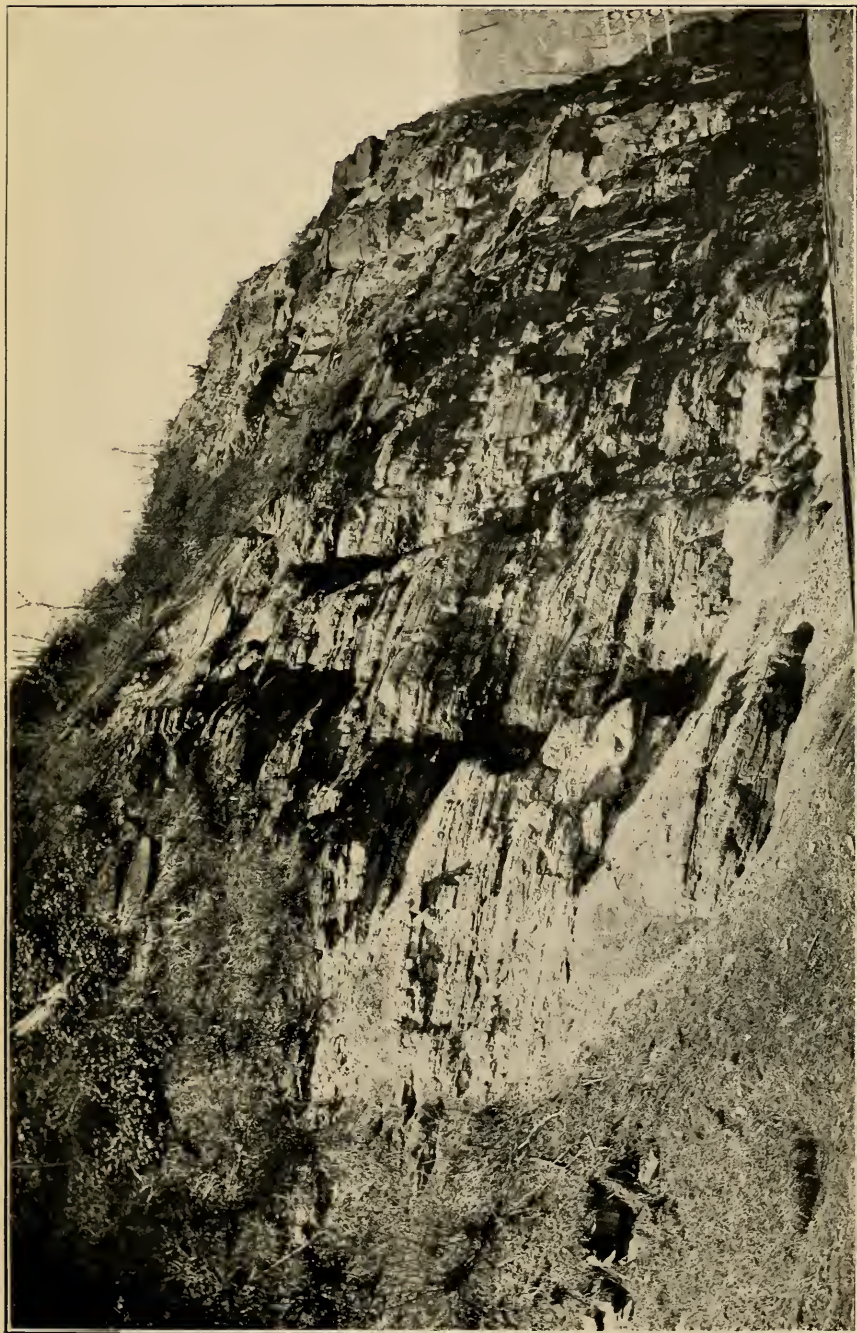


PLATE XIX.—Showing upper portion of the Catskill Series in B. & O. Ry. cut south of Manheim. Photo by E. E. Knight.

		Thickness Ft. In.	Total Ft. In.
Coal	0' 4½"	Upper Freeport... Coal	10 2½ 186 0½
Bone	0 3¾		
Coal	0 2		
Bone	0 1½		
Coal	0 7¼		
Coal, streaks of bone	0 10		
Coal	2 11¼		
Slate	0 2½		
Coal	1 1½		
Slate	1 0		
Coal	1 5½	Lower Freeport... Coal	1 1 252 1
Slate	0 1½		
Coal, little sulphur..	0 11½		
Fire clay, limestone (Upper Freeport) and sandstone			
Shale, green, and sandstone.....			
Sandstone, Upper Freeport, gray.....			
Bony coal and slate...0' 2"			
Coal	0 11		
Fire clay, very soft.....			
Shale, green, and sandstone.....			
Sandstone, Lower Freeport, gray, hard, pebbly		76 4	335 11
Slate, black, bituminous broken, Middle Kittanning coal horizon.....		8 5	344 4
Shale		44 8	389 0
Fire clay, Lower Kittanning.....		17 0	406 0
Shale		10 10	416 10
Sandstone, gray		6 1	422 11
Slate		0 11	423 10
Coal		0 1	423 11
Shale		7 6	431 5
Coal and slate, mixed..1' 5"		9 1	440 6
Fire clay.....6 5			
Coal, slate and bony coal 1 3		12 10	453 4
Fire clay, Clarion			
Sandstone, very hard, Homewood, and unrecorded		54 5	507 9
Slate		1 7	509 4
Bone coal.....0' 5½"		3 8	513 0
Coal, could not make core	3 2½		
Unrecorded		21 2	534 2

Amos Ashburn Core Test No. 1 (43).

Valley district, 1.3 miles N. 10° E. of Reedsville. Authority, Elkins Coal & Coke Co. Elevation, 1698' L-A. T.

	Thickness Ft. In.	Total Ft. In.
Unrecorded	180 0	180 0
Black slate and sulphur.....	0 7½	180 7½

		Thickness Ft. In.	Total Ft. In.
Coal, full of sulphur.	0' 2½"		
Bone	0	8	
Slate, black	0	1½	
Coal, full of sulphur.	0	8½	
Bone	1	3	
Coal	0	2½	
Bone	0	0½	
Coal	2	3	
Slate	0	2½	
Coal	1	2½	
Slate	0	0½	
Coal	0	4	
Slate	0	11	
Coal	1	4½	
Slate	0	2	
Coal	0	11	
Unrecorded	.....	39 9	231 0

Upper
Freeport...
Coal

Ashburn Core Test No. 16 (44).

Valley district, 1.4 miles S. 10° W. of Masontown. Authority, Elkins Coal & Coke Co.

	Thickness Ft. In.	Total Ft. In.
Surface	12 0	12 0
Sandstone (Buffalo)	23 0	35 0
Fire clay	2 0	37 0
Shale, light, sandy	15 0	52 0
Shale, dark, sandy	13 0	65 0
Shale, dark	9 6	74 6
Bone coal (Brush Creek)	1 0	75 6
Fire clay	12 0	87 6
Shale, light, sandy	9 6	97 0
Fire clay (Thornton) and shale	16 0	113 0
Shale, light, sandy	20 0	133 0
Sand rock	18 10	151 10
Soapstone	3 0	154 10
Bone and slate	2' 4 "	
Coal	1	3
Bone	0	8½
Coal	2	6½
Binder	0	0½
Coal	1	7
Binder	0	10
Coal	1	3

Upper
Freeport...
Coal

Fawcett Core Test No. 15 (45).

Valley district, 1.3 miles S. 15° W. of Masontown. Authority, Elkins Coal & Coke Co. Elevation, about 1810' B-A. T.

	Thickness Ft. In.	Total Ft. In.
Surface	5 0	5 0
Sandstone	17 0	22 0

	Thickness		Total	
	Ft.	In.	Ft.	In.
Shale, dark	9	0	31	0
Shale, light, sandy.....	10	0	41	0
Sandstone (Buffalo)	23	0	64	0
Shale, dark	4	10	68	10
Bone and coal (Brush Creek).....	0	10	69	8
Fire clay	9	0	78	8
Fire clay and shale.....	11	0	89	8
Shale, light, sandy.....	6	0	95	8
Fire clay and shale (Thornton).....	12	4	108	0
Sandstone	6	0	114	0
Shale, light	2	0	116	0
Sandstone, (Lower Mahoning).....	32	0	148	0
Soapstone	5	6	153	6
Bone and slate.....1' 3 "	}	Upper Freeport... Coal	9	3
Bone and coal.....1 2				
Coal 3 10½				
Binder 0 0½				
Coal 0 3				
Binder 1 0				
Coal 1 8			162	9

William Welton Core Test No. 19 (47).

Valley district, 1.6 miles N. 35° W. of Reedsville. Authority, Elkins Coal & Coke Co. Completed, October 29, 1909. Elevation, 1699' L-A. T.

	Thickness		Total	
	Ft.	In.	Ft.	In.
Surface	12	6	12	6
Sandstone (Mahoning)	30	6	43	0
Slate, dark	16	4	59	4
Fire clay	1	6	60	10
Bone and coal.....1' 5 "	}	Upper Freeport... Coal	8	2½
Coal 2 5				
Binder 0 2½				
Coal 1 1½				
Binder 0 0½				
Coal 0 5				
Binder 0 10	}		0	11½
Coal 0 11				
Binder 0 3				
Coal 0 7				
Fire clay (Bolivar) to bottom.....	0	11½	70	0

Rogers Core Test No. 27 (48).

Valley district, 2.2 miles S. 45° W. of Masontown. Authority, Elkins Coal & Coke Co. Completed, January 1, 1910. Elevation, 1717.6' L-A. T.

	Thickness		Total	
	Ft.	In.	Ft.	In.
Surface	14	0	14	0
Fire clay and shale.....	10	0	24	0
Bone and shale (Upper Kittanning).....	0	4	24	4

	Thickness	Total
	Ft. In.	Ft. In.
Shale, dark, sandy.....	3 8	28 0
Sand rock.....	20 0	48 0
Sandstone and coal spars (Middle Kittanning coal)	3 0	51 0
Sandstone	9 0	60 0
Sandstone and dark shale.....	10 0	70 0
Slate, black	12 0	82 0
Fire clay	3 0	85 0
Sandstone	2 0	87 0
Slate, black.....	3 6	90 6
Coal and bone.....0' 6"	} Lower Kittanning Coal. 3 1	93 7
Coal		
Sulphur		
Coal		
Bone coal.....		
Binder		
Coal	}	
Bastard fire clay.....		
Black slate and fire clay.....		
Fire clay (Lower Kittanning).....		
Shale		
Fire clay and black slate.....		
Fire clay	4 0	114 0
Black slate and bone.....	0 9	114 9
Slate, black	1 3	116 0
Black slate and bone (Clarion coal horizon)	1 0	117 0
Fire clay	7 0	124 0
Sandstone and shale.....	14 0	138 0
Conglomerate (Homewood).....	5 0	143 0

The above boring starts about 15 feet below the crop of the Upper Freeport coal.

Overfield Core Test No. 25 (49).

Valley district, 1.6 miles N. 60° W. of Reedsville. Authority, Elkins Coal & Coke Co. Completed, December 11, 1909. Elevation, 1825.8' L.A. T.

	Thickness	Total
	Ft. In.	Ft. In.
Surface	4 0	4 0
Sandstone, (Mahoning).....	48 0	52 0
Slate, dark	9 0	61 0
Fire clay	1 7	62 7
Bone and coal.....0' 10"	} (Upper Freeport... Coal)	69 0
Coal		
Binder		
Coal		
Binder		
Coal to bottom.....		

Wm. Guseman Core Test No. 24 (50).

Valley district, 1.3 miles N. 70° W. of Reedsville. Authority Elkins Coal & Coke Co. Completed, December 6, 1909. Elevation, 1729' L-A. T.

	Thickness		Total	
	Ft.	In.	Ft.	In.
Surface	12	0	12	0
Sandstone (Mahoning)	30	0	42	0
Shale, light	7	0	49	0
Shale, dark, sandy.....	8	0	57	0
Sandstone, dark.....	6	0	63	0
Fire clay.....	0	7	63	7
Bone and coal.....0' 6 "	}	(Upper Freeport... Coal)	6	11
Coal 2 7½				
Binder 0 1				
Coal 1 7½				
Binder 0 10				
Coal 0 9				
Binder 0 3				
Coal 0 3	}		0	6
Fire clay (Bolivar) to bottom.....				
			71	0

Wm. Guseman Core Test No. 23 (51).

Valley district, 1.3 miles N. 75° W. of Reedsville. Authority, Elkins Coal & Coke Co. Elevation, 1789.5' L-A. T.

	Thickness		Total	
	Ft.	In.	Ft.	In.
Surface	6	0	6	0
Shale, sandy.....	4	0	10	0
Shale, dark.....	33	0	43	0
Bone coal (Brush Creek coal).....	0	4	43	4
Fire clay	14	0	57	4
Shale, light.....	4	0	61	4
Shale, light, sandy.....	11	4	72	8
Sand rock (Upper Mahoning).....	20	6	93	2
Soapstone	2	0	95	2
Fire clay.....3' 6"	}	(Thornton fire clay..	16	0
Shale, light, sandy.....9 6				
Fire clay.....3 0				
Shale, light	11	0	122	2
Sand rock and shale (Lower Mahoning)..	12	6	134	8
Dark shale and fire clay.....	8	0	142	8
Bone and coal.....0' 1"	}	(Upper Freeport... Coal)	6	8
Coal 4 2				
Binder 0 10				
Coal 0 10				
Binder 0 3				
Coal 0 6				
Fire clay (Bolivar) to bottom.....	1	4	150	8

Keck Core Test No. 17 (52).

Valley district, 0.8 mile N. 40° W. of Reedsville. Authority, Elkins Coal & Coke Co. Completed, October 15, 1909. Elevation, 1709' L-A. T.

	Thickness		Total
	Ft.	In.	Ft. In.
Surface	10	6	10 6
Sandstone (Mahoning)	64	0	74 6
Soapstone	4	6	79 0
Fire clay	1	2	80 2
Bone and shale.....0' 8 "	}	(Upper Freeport... Coal)	87 6
Bone and coal.....0 8			
Coal			
Binder			
Coal			
Binder			
Coal			
Binder	0	10	89 4
Coal	1	3	
Fire clay (Bolivar) to bottom.....	1	10	

Core Test No. 4 (53).

Valley district, 0.5 mile N. 70° W. of Reedsville. Authority, Elkins Coal & Coke Co. Elevation, 1755' B-A. T.

	Thickness		Total
	Ft.	In.	Ft. In.
Surface	4	11	4 11
Sandstone, rotten.....6' 2" } (Salts-	14	6	19 5
Sandstone, gray.....8 4 } burg).....			
Slate, soft.....	0	5	19 10
Sandstone, gray.....	0	7	20 5
Fire clay (horizon Bakerstown coal).....	2	1	22 6
Fire clay, green shale, and gray sandstone, mixed	21	2	43 8
Sandstone, gray.....	15	5	59 1
Fire clay	9	9	68 10
Sandstone, gray, Buffalo.....	26	9	95 7
Conglomerate, coarse and sandstone, mixed	5	10½	101 5½
Coal	0	1	101 6½
Conglomerate, coarse and sandstone, mixed	0	6½	102 1
Coal	0	2	102 3
Sandstone, gray.....	6	5	108 8
Slate, sandy, streaks of sandstone.....	13	6	122 2
Coal (Brush Creek).....	0	3	122 5
Fire clay	8	4	130 9
Shale, green, sandy.....	22	7	153 4
Fire clay and green shale (Thornton)....	5	3	158 7
Sandstone, gray (Mahoning).....	40	9	199 4
Shale, sandy, and fine grained, gray sandstone, very hard and broken.....	28	1	227 5

	Thickness Ft. In.	Total Ft. In.
Coal and bone.....0' 8 "	(Upper Freeport... Coal)	235 1
Coal 2 4½		
Slate 0 0½		
Coal 1 3½		
Slate 0 0½		
Coal 0 5		
Slate 1 2½		
Coal, little streaks of slate and sulphur.1 7½		
Fire clay (Bolivar) to bottom.....	8 10½	243 11½

Fairfax Core Test No. 21 (54).

Valley district, 0.3 mile S. 80° E. of Reedsville. Authority, Elkins Coal & Coke Co. Completed, November 12, 1909. Elevation, 1772.3' L-A. T.

	Thickness Ft. In.	Total Ft. In.
Surface	14 0	14 0
Fire clay.....	16 0	30 0
Sandstone	23 0	53 0
Fire clay	9 0	62 0
Shale, light.....	8 0	70 0
Sandstone, hard (Buffalo).....	36 0	106 0
Shale, dark, sandy, (Brush Creek).....	15 9	121 9
Coal (Brush Creek).....	0 6	122 3
Fire clay	12 9	135 0
Shale, light.....	5 0	140 0
Fire clay and shale (Thornton).....	14 0	154 0
Shale, light.....	4 0	158 0
Sandstone (Mahoning).....	45 6	203 6
Shale, dark, sandy.....	14 9	218 3
Bone coal.....0' 10 "	(Upper Freeport... Coal)	225 3½
Coal 2 4½		
Binder 0 3		
Coal 1 0		
Binder 0 0¼		
Coal 0 3¼		
Binder 0 11½		
Coal 0 10		
Binder 0 2	1 8½	227 0
Coal 0 4		
Fire clay		

The Merchants Coal Company sank 6 bore holes (Nos. 55 to 60, inclusive) in the southern edge of Valley district in the vicinity of Browns Mills and northwest thereof. The Survey was unable to obtain any information concerning these tests.

Lyon District.

Ten coal test borings have been drilled in Lyon district, the locations of which are exhibited on Map II. The Survey was able to obtain the logs of only six. The record of the Hamilton Coal & Coke Company boring (68), located at Newburg, is published in connection with the section for the latter place, page 89.

The logs of the others will now be given:

Calvin Cornwall Bore Hole No. 2 (63).

Lyon district, on Cooks run, 1 mile N. E. of Independence. Authority. Preston Fuel Co. Elevation, 1310' B.A. T.

	Thickness		Total
	Ft.	In.	Ft. In.
Boulders, sand, etc.....	7	6	7 6
Sandstone	12	2	19 8
Shale	1	9	21 5
Soft slaty shale.....	0	9	22 2
Slaty shale	28	4	50 6
Slate	1	2	51 8
Coal 0' 1" } Brush			
Coal 0 11 } Creek.....	1	0	52 8
Bastard limestone.....	2	5	55 1
Soft shale	19	8	74 9
Sandstone, shale	5	0	79 9
Green shale, soft.....	7	0	86 9
Green shale	3	2	89 11
Fine grained sandstone.....	13	6	103 5
Soft slate	0	8	104 1
Green and red shale, mixed.....	13	8	117 9
Green shale	15	3	133 0
Red and green shale.....	2	9	135 9
Mixed shale	9	6	145 3
Dark shale (Upper Freeport coal horizon)	8	6	153 9
Sandy shale	10	2	163 11
Shale	2	2	166 1
Bastard limestone.....0' 10" } Upper			
Shale 2 6 } Freeport...	8	3	174 4
Bastard lime and shale 4 11 } Limestone			
Shale, little sandy.....	10	11	185 3
Shale	6	6	191 9
Fire clay and shale.....	3	4	195 1
Soft shale	11	4	206 5
Shale	6	2	212 7
Slate and fire clay.....	0	11	213 6
Fire clay, slaty.....	2	2	215 8
Shale	2	1	217 9
Shale and slate.....	1	9	219 6
Bony coal (Lower Freeport).....	0	3½	219 9½
Soft shale	3	8½	223 6
Sandy shale	4	8	228 2

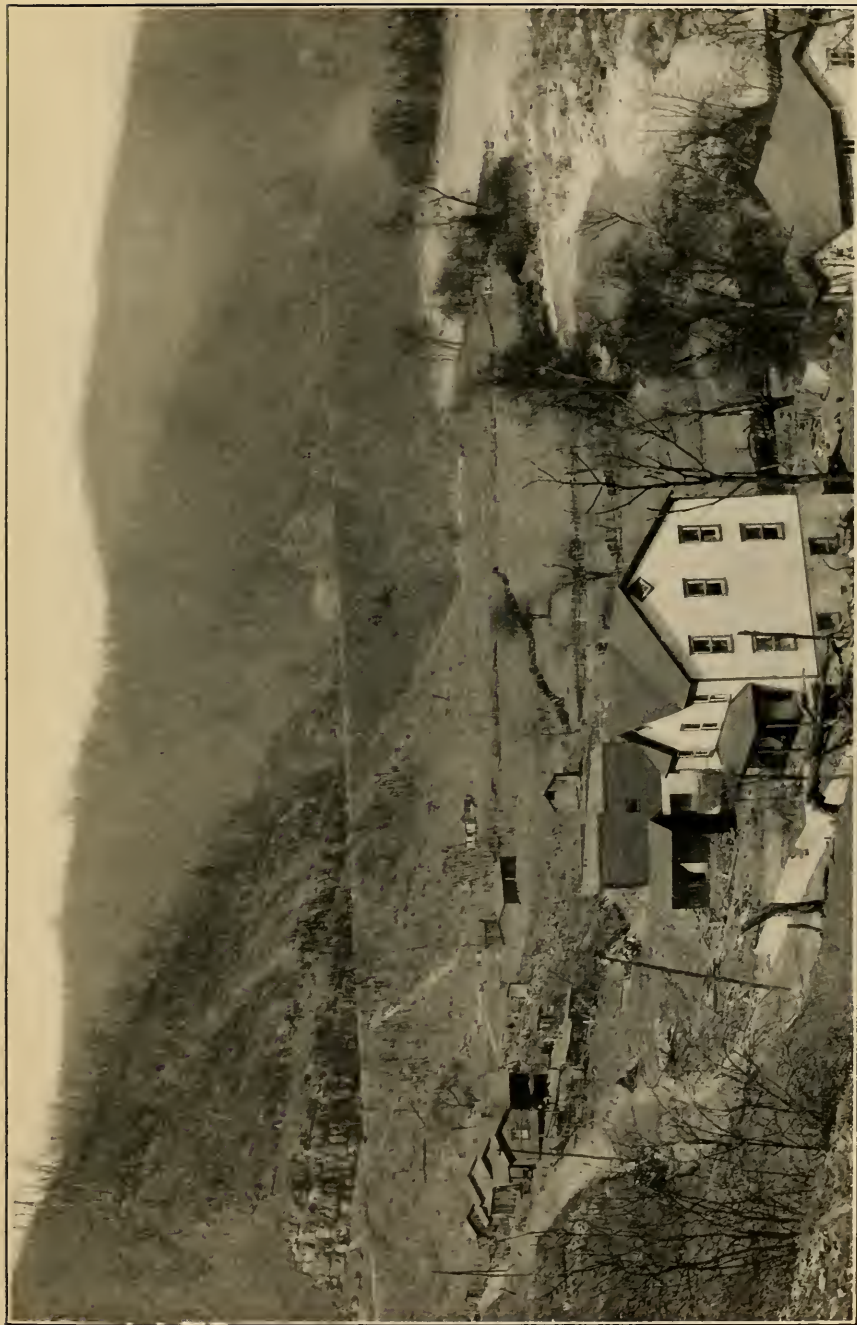


PLATE XX.—Showing rapidly dipping strata of the Chemung, Catskill, Pocono, Greenbrier and Pottsville rocks, one-eighth mile east of Kyer Run. Heavy cliff at left near base of Catskill Series.

Photo by E. E. Knight

		Thickness Ft. In.	Total Ft. In.
Dark, fine grained sandstone	9' 3"	56 3	284 5
Dark sandstone.....	10 10		
Gray sandstone.....	31 2		
Gray sandstone.....	5 0		
Bony coal (Upper Kittanning).....		0 1	284 6
Sand slate and sandstone.....		3 0	287 6
Shale and sandstone.....		1 10	289 4
Sandstone streaks and slate.....		4 9	294 1
Sand slate streaks and stone.....		12 4	306 5
Fire clay, little slaty.....		9 7	316 0
Sandstone and sand slate mixed.....		9 6	325 6
Dark sandstone		10 5	335 11
Dark sandstone and shale mixed.....		10 10	346 9
Sandstone		2 1	348 10
Coal	1' 9"	5 2	354 0
Coal	.0 10		
Slate	.0 1		
Coal	.0 11		
Soft fire clay.....	.0 9		
Coal, not so good.....	.0 10		
Sandstone, mixed		0 7½	354 7½
Fire clay, sandy.....		7 5½	362 1
Gray sandstone, very hard	25' 8"	29 10	391 11
Sandstone	4 2		
Sand slate		6 8	398 7
Black slate		4 7	403 2
Coal, little seams of slate	.0' 11½"	3 4	406 6
Slate	.0 1		
Coal	.0 9½		
Slate	.0 5		
Coal	.0 7		
Slate, little bony coal	0 4		
Coal	.0 2	6 4	412 10
Dark shale			
Sandstone, very hard (Homewood).....		19 5	432 3

The following proximate analysis of the Lower Kittanning coal in the above boring, made by Smith & Rudy, Chemists, was furnished by the Preston Fuel Company:

***Analysis, Lower Kittanning Coal.**

	Per cent.
Moisture	.61
Vol. Comb. Matter.....	29.98
Fixed Carbon	53.82
Ash	15.59
	100.00
Sulphur	2.48
B. T. U.....	13,178

*Smith, Rudy & Co., Chemists

The above analysis does not show the Lower Kittanning coal as high in British Thermal Units or as low in ash as do the results of tests by the Survey (see table of coal analyses at the end of this chapter).

J. H. Larew Hrs. Core Test No. 1 (65).

Lyon district, 0.4 mile S. 45° W. of Independence. Authority.
Preston Fuel Co. Elevation, 1150' B.A. T.

	Thickness Ft. In.	Total Ft. In.
Surface	6 0	6 0
Gray rock, sand and gravel.....	3 6	9 6
Shale, greenish, soft and seamy.....	5 6	15 0
Shale, greenish, broken.....	7 11	22 11
Rock, pinkish, broken.....	4 4	27 3
Shale, green	1 0	28 3
Fire clay, slaty (top of Upper Freeport coal horizon).....	9 11	38 2
Shale, green, sandy.....	2 7	40 9
Shale, slaty and soft.....	12 5	53 2
Shale, slaty and sandy.....	8 8	61 10
Limestone, bastard.....0' 5" } (Upper		
Slate 1 0 } Freeport..	6 9	68 7
Limestone, bastard.....5 4 } Limestone)		
Fire clay, slaty.....	5 0	73 7
Shale, green.....	3 3	76 10
Shale, a little sand.....	11 0	87 10
Shale	12 9	100 7
Shale	7 7	108 2
Shale, little sandstone mixed.....	10 6	118 8
Shale, little slate.....	4 2	122 10
Slate	0 10	123 8
Shale	3 9	127 5
Sand slate.....	8 2	135 7
Sand slate.....	0 5	136 0
Slate	1 2	137 2
Coal 0' 6 " } (Upper		
Slate 0 1½ } Kittanning	1 4	138 6
Coal 0 8½ } Coal)		
Fire clay (Upper Kittanning).....	1 7	140 1
Shale, green sandy.....	9 11	150 0
Shale, sandy.....	9 0	159 0
Sandstone, shaly.....	6 2	165 2
Slate	1 4	166 6
Coal 5' 6" } (Middle Kittan-		
Coal 1 0 } ning Coal)..	6 6	173 0
Slate	0 3	173 3
Fire clay.....	8 11	182 2
Shale, sandy.....	3 5	185 7
Shale	4 5	190 0
Slate, light.....	2 10	192 10
Slate, light.....	2 5	195 3

		Thickness	Total
		Ft. In.	Ft. In.
Slate		9 7	204 10
Coal, little seams of slate 1' 4 "	(Lower Kittanning Coal)		
Slate 0 7½			
Coal 1 2		8 4	213 2
Slate 0 3½			
Coal 3 7			
Fire clay.....0 7			
Coal 0 9			
Sandstone, slaty.....		0 11	214 1
Fire clay.....1' 2" } (Lower Kittanning		1 9	215 10
Fire clay.....0 7 } Fire Clay)			
Rock gray, very hard, to bottom.....		10 11	226 9

Austen Coal & Coke Co. Bore Hole No. 1 (70).

Lyon district, 1.2 miles westward from Austen. Authority, Austen Coal & Coke Co. Completed, May 9, 1905. Elevation, 1370' B-A. T.

		Thickness	Total
		Ft. In.	Ft. In.
Surface		7 0	7 0
Shale rock.....		3 0	10 0
Sand rock.....		5 0	15 0
Black hard rock.....		4 6	19 6
White sandstone (Lower Freeport, upper division)		37 0	56 6
Sandy slate.....		10 0	66 6
Coal 1' 2" } (Upper	Kittanning		
Sandy slate.....6 0 } Coal)		7 4	73 10
Coal 0 2			
Slate		8 6	82 4
Slate and fire clay.....		9 0	91 4
Sand rock (Lower Freeport, lower division)		45 8	137 0
Slate		13 6	150 6
Coal and slate.....0' 6 "	(Lower Kittanning Coal)		
Coal 1 1			
Parting 0 1¼			
Coal 0 8		6 4	156 10
Parting 0 1½			
Coal 2 1			
Parting 0 2			
Coal 1 7¼			
Fire clay, to bottom.....		7 0	163 10

The above boring starts about 75 feet below the horizon of the Upper Freeport coal.

Austen Coal & Coke Co. Core Test No. 3 (72).

Lyon district, 0.3 mile N. 10° E. of Austen. Authority, Austen Coal & Coke Co. Completed, 1906. Elevation, 1450' B-A. T.

		Thickness	Total
		Ft. In.	Ft. In.
Surface		7 0	7 0
Sand rock.....19' 0"	} (Lower Freeport Sandstone lower division).	27 0	34 0
Sand rock and coal spars 1 0			
Sand rock.....3 0			
Sand rock, hard, and coal spars.....4 0			
Light shale and soapstone.....		5 0	39 0
Hard sand rock and coal spars.....		1 0	40 0
Coal, bony, (Middle Kittanning).....		0 6	40 6
Sandstone		5 0	45 6
Sand rock.....		21 6	67 0
Shale, variegated.....		4 0	71 0
Soapstone and shale.....		5 0	76 0
Fire clay (Lower Kittanning).....		3 0	79 0
Sand rock.....		44 0	123 0
Coal spars and sand rock.....		0 6	123 6
Sand rock.....		7 6	131 0
Sand rock, hard, and coal spars.....		10 0	141 0
Fire clay and shale.....		1 8	142 8
Coal 0' 11"	} (Clarion Coal).....	7 9	150 5
Fire clay.....1 0			
Fire clay and shale...4 9			
Bony coal....0' 5" } ..1 1			
Coal 0 8 }			
Fire clay (Clarion).....		1 3	151 8
Sand rock, to bottom, (Homewood).....		1 0	152 8

The above boring starts about 140 feet below the Upper Freeport coal vein.

Austen Coal & Coke Co. Core Test No. 5 (73).

Lyon district, 0.6 mile S. 10° E. of Austen. Authority, Austen Coal & Coke Co. Elevation, 1610' B-A. T.

		Thickness	Total
		Feet.	Feet.
Sandstone and unrecorded.....		50.0	50.0
Black slate and soapstone.....		4.0	54.0
Sandstone		10.0	64.0
Coal (Brush Creek).....10"		0.9	64.9
Slate and fire clay.....		19.1	84.0
Coal and slate (Mahoning).....6"		0.5	84.5
Fire clay and soapstone (Thornton fire clay)...		6.5	91.0
Sandstone		47.0	138.0
Coaly slate.			
Coal	4' 0"	5.5	143.5
Slate	0 8		
Coal	0 10		
		(Upper Freeport Coal)	
		(Record uncertain)	
Slate and fire clay.....		11.5	155.0
Coal (Lower Freeport?).....		4.5	159.5
Soapstone		1.5	161.0

"Stopped boring at 161 feet from top of rock. 9 feet from top of stand pipe to rock."

"Henry J. Wilson, Eng. in Charge."

The foregoing logs for Lyon district borings show the Allegheny coals quite irregular in thickness. The Lower Kittanning in the region of Newburg and Independence has become the most important coal in the Ligonier Basin, in direct contrast to what happens northeastward in Valley district.

Kingwood District.

Fifteen bore holes to test the coals have been drilled in Kingwood district, the most of which are grouped in the area lying northward from Kingwood along the eastern slope of the Preston anticline. The Survey was able to obtain the logs of only nine, which follow herewith:

Isaac Foreman Core Test No. 13 (74).

Kingwood district, 1.9 miles N. 10° W. of Kingwood. Authority, Elkins Coal & Coke Co. Elevation, 2025' B.A. T.

	Thickness		Total	
	Ft.	In.	Ft.	In.
Surface	5	0	5	0
Sand rock.....	13	0	18	0
Fire clay	8	0	26	0
Light shale	7	0	33	0
Sand rock (Buffalo).....	48	6	81	6
Light sandy shale.....	5	0	86	6
Dark shale (Brush Creek).....	8	6	95	0
Coal (Brush Creek).....	0	4	95	4
Fire clay.....	11	8	107	0
Light, sandy shale.....	17	0	124	0
Fire clay (Thornton).....	5	0	129	0
Light, sandy shale.....	8	0	137	0
Sand rock (Mahoning).....	36	0	173	0
Soapstone	3	6	176	6
Sand rock (Mahoning).....	16	6	193	0
Sand rock and shale.....	1	8	194	8
Bone coal.....0' 4 " }				
Coal 1 1 }				
Bone coal.....1 0 }				
Coal 2 7½ }				
Binder 0 2½ }				
Coal 1 0 }				
Binder 0 0¼ }				
Coal 0 3¾ }				
Binder 0 10½ }				
Coal 1 6 }				
Binder 0 1½ }				
Coal 1 3 }				
Fire clay.....	1	8	205	8

(Upper
Freeport.. 10 4
Coal)

J. W. Ridenour Core Test No. 3 (74A).

Kingwood district, 1.3 miles N. 10° W. of Kingwood. Authority, Elkins Coal & Coke Co. Elevation, 1949.59' L.A. T.

	Thickness		Total	
	Ft.	In.	Ft.	In.
Soil and clay.....	15	0	15	0
Fire clay and sandstone.....	10	0	25	0
Sandstone, gray, Mahoning.....	8	0	33	0
Sandstone, yellow, Mahoning.....	0	9	33	9
Sandstone, gray, Mahoning.....	16	3	50	0
Conglomerate sandstone, Mahoning.....	4	10	54	10
Black slate and bone coal, "roof coal".1' 0 "				
Coal	3	4		
Slate	0	1½		
Coal	1	4½		
Fire clay.....	1	2		
Slate, black.....	0	5		
Coal	0	3		
Slate	0	1½		
Coal	0	5½		
Fire clay (Bolivar).....	2	7	65	8

(Upper
Freeport...
Coal)

W. G. Brown Core Test No. 12 (74B).

Kingwood district, 1.8 miles east of Manown station. Authority, Elkins Coal & Coke Co. Completed, June 21, 1910. Elevation, 2211.86' L-A. T.

	Thickness		Total	
	Ft.	In.	Ft.	In.
Surface	2	6	2	6
Sandstone (Buffalo).....	20	0	22	6
Shale, light, sandy.....	28	6	51	0
Shale, dark, (Brush Creek).....	29	0	80	0
Fire clay (Brush Creek coal horizon)....	2	0	82	0
Shale, light, sandy.....	4	6	86	6
Fire clay and shale.....	5	6	92	0
Limestone	4	0	96	0
Fire clay	5	0	101	0
Fire clay and lime.....	2	0	103	0
Fire clay	1	0	104	0
Shale, light.....	6	0	110	0
Fire clay (Thornton).....	4	0	114	0
Shale, light, sandy.....	18	0	132	0
Sandstone (Mahoning).....	29	0	161	0
Soapstone	1	8	162	8
Coal	1'	6"		
Bone	0	7		
Coal	3	2		
Binder	0	1		
Coal	1	5		
Binder	0	8		
Coal	1	7		
Binder	0	1		
Coal	0	10		
Fire clay.....	3'	3"		
Fire clay and lime.....	3	2		
Fire clay.....	5	0		

(Upper
Freeport...
Coal)

(Bolivar fire
clay)

	Thickness		Total	
	Ft.	In.	Ft.	In.
Shale, light, sandy.....	22	0	206	0
Shale, dark, sandy.....	28	0	234	0
Soapstone	5	0	239	0
Sand rock and shale.....	4	6	243	6
Slate, black.....	1	0	244	6
Fire clay	1	0	245	6
Coal (Lower Freeport).....	2	1	247	7
Fire clay and shale.....	6	0	253	7
Shale, light, sandy.....	24	5	278	0
Sandstone (Lower Freeport, upper division)	27	10	305	10
Bone and coal.....1' 0"	1	11	307	9
Slate				
Coal				
Fire clay and shale (Upper Kittanning fire clay).....	3	3	311	0
Shale, dark, sandy.....	16	0	327	0
Shale, dark.....	6	0	333	0
Fire clay.....5' 0"	23	0	356	0
Fire clay, hard.....15 0				
Fire clay.....3 0				
Light shale	7	4	363	4

W. G. Brown Core Test No. 10 (74C).

Kingwood district, along south edge of private road, 1¾ miles S. E. of Manown station. Authority, Elkins Coal & Coke Co. Completed, May 24, 1910. Elevation 2171.33' L-A. T.

	Thickness		Total	
	Ft.	In.	Ft.	In.
Surface	6	0	6	0
Sandstone (Upper Mahoning).....	40	0	46	0
Shale, light	13	0	59	0
Sandstone (Lower Mahoning).....	38	6	97	6
Soapstone	1	0	98	6
Coal and soapstone streaks 1' 3 "	10	0	108	6
Bone				
Coal				
Binder				
Coal				
Binder				
Coal and soapstone streaks 0 8				
Binder				
Coal				
Binder				
Coal				
Binder				
Coal				
Coal				
Fire clay (Bolivar).....	0	6	109	0

W. G. Brown Core Test No. 11 (74D).

Kingwood district, 1.5 miles east of Manown station. Authority, Elkins Coal & Coke Co. Completed, May 31, 1910. Elevation, 2237.64' L-A. T.

	Thickness		Total	
	Ft.	In.	Ft.	In.
Surface	13	0	13	0
Sandstone (Upper Mahoning)....26'	56	0	69	0
Sandstone, hard, and coal spars. 4				
Sandstone, hard.....19				
Sandstone, coarse, hard.....7	12	0	81	0
Shale, light, sandy, (Uffington).....				
Sandstone (Lower Mahoning).....	27	0	108	0
Soapstone	5	6	113	6
Coal 1' 1 "	9	6½	123	0½
Binder 0 1½				
Bone 0 7				
Coal 3 3				
Binder 0 0½				
Coal 1 6				
Binder 0 10				
Coal 1 0				
Binder 0 2				
Coal 0 3				
Binder 0 0½	0	10½	123	11
Coal 0 8				
Fire clay (Bolivar).....				

Garlutz Core Test No. 9 (74E).

Kingwood district, on second-class road, 1.2 miles S. E. of Manown station. Authority, Elkins Coal & Coke Co. Completed, May 18, 1910. Elevation 2287.2' L-A. T.

	Thickness		Total	
	Ft.	In.	Ft.	In.
Surface	3	6	3	6
Sandstone (Buffalo)	26	0	29	6
Shale, dark (Brush Creek).....	23	6	53	0
Sandstone	14	0	67	0
Shale, dark, sandy.....	3	0	70	0
Sandstone, hard	16	0	86	0
Sandstone, coarse, hard.....	10	0	96	0
Soapstone	9	0	105	0
Shale, sandy	8	0	113	0
Sandstone	9	0	122	0
Soapstone and shale.....	11	0	133	0
Sandstone	3	0	136	0
Soapstone	7	0	143	0

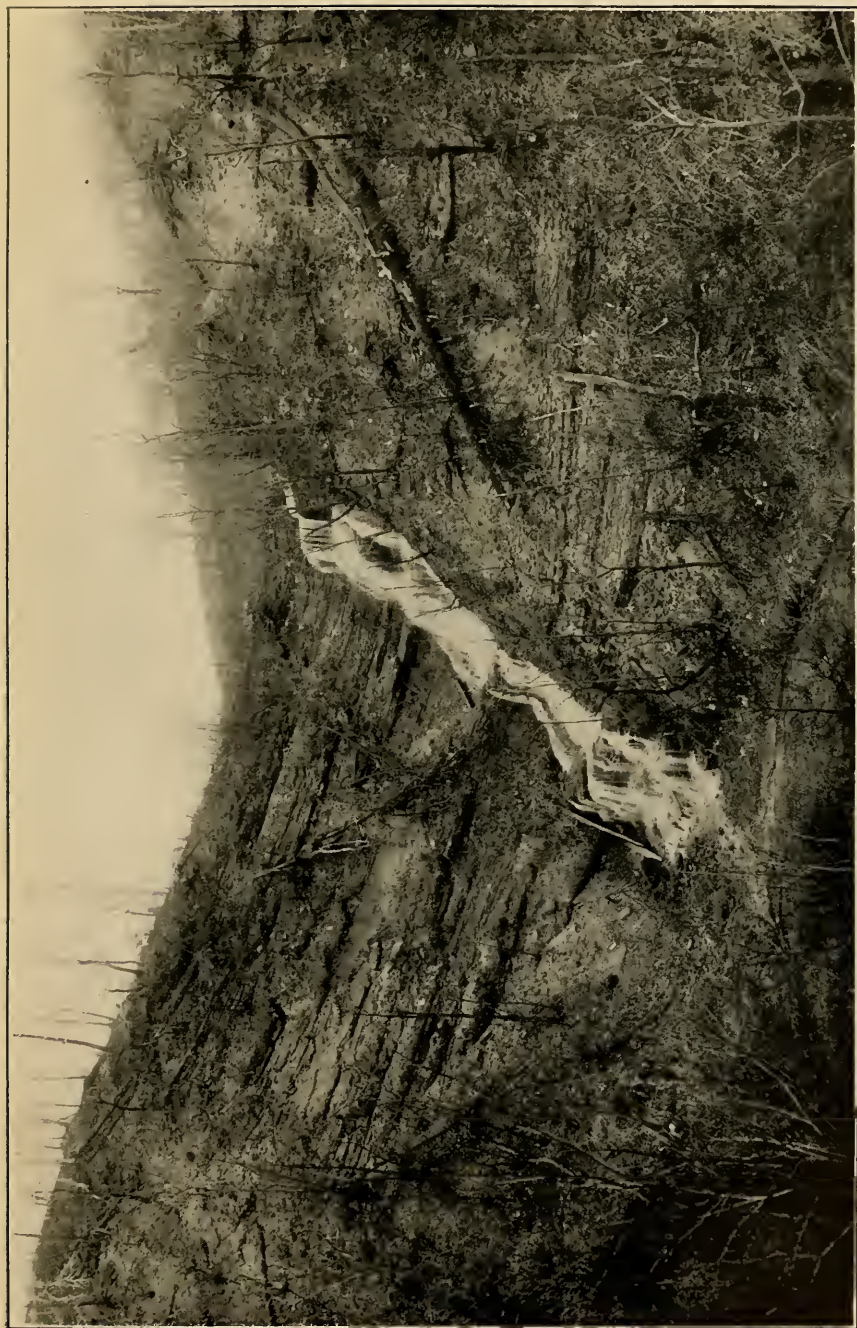


PLATE XXI.—Falls of Salt Lick, 1 mile west of Terra Alta and $\frac{1}{2}$ mile west of the crest of the Briery Mountain Anticline, showing local syncline and bedding of Chemung rocks.

Photo by E. E. Knight

	Thickness Ft. In.	Total Ft. In.
Coal	0' 11 "	
Bone	1 0	
Coal	2 8½	
Binder	0 1	
Coal	1 5	
Binder	0 11	
Coal	0 3	
Binder	0 1	
Coal	0 2	
Binder	0 2	
Coal	0 3	
Binder	0 2	
Coal	0 8	
Binder	0 2½	
Coal	0 11	
Fire clay (Bolivar) to bottom.....	1 1	154 0

(Upper
Freeport.. .9 11
Coal)

Fawcett Coal Test No. 8 (74F).

Kingwood district, 1.2 miles southeast of Manown on south edge of Kingwood Pike. Authority, Elkins Coal & Coke Co. Completed, May 11, 1910. Elevation 2329.65' L-A. T.

	Thickness Ft. In.	Total Ft. In.
Surface	3 0	3 0
Sandstone	7 0	10 0
Shale, dark, sandy.....	5 0	15 0
Sandstone	8 0	23 0
Sandstone and coal spars.....	3 0	26 0
Sandstone	6 0	32 0
Shale, dark, sandy.....	5 0	37 0
Sandstone, coarse, hard..26' }	(Mahoning) 51 0	88 0
Sandstone		
Soapstone	2 4	90 4
Bone	1' 6 "	
Coal	2 10	
Binder	0 0½	
Coal	1 7½	
Binder	1 0	
Coal	0 4	
Binder	0 2	
Coal	0 10	
Binder	0 2½	
Coal	0 8½	
Fire clay (Bolivar) to bottom.....	1 5	101 0

(Upper
Freeport.. 9 3
Coal)

John Greaser Coal Test No. 7 (74G).

Kingwood district, 1.5 miles southeast of Manown station, along Kingwood Pike. Authority, Elkins Coal & Coke Co. Completed, May 6, 1910. Elevation 2194.83' L-A. T.

	Thickness Ft. In.	Total Ft. In.
Surface	13 0	13 0
Shale, dark, sandy.....	21 0	34 0

	Thickness	Total
	Ft. In.	Ft. In.
Sandstone and coal spars.....	2 0	36 0
Sandstone (Upper Mahoning).....	25 6	61 6
Sandstone and coal spars.....	2 0	63 6
Sandstone	12 6	76 0
Fire clay and shale (Thornton).....	7 6	83 6
Sandstone (Lower Mahoning).....	20 6	104 0
Soapstone	3 0	107 0
Sandstone	5 6	112 6
Soapstone	3 6	116 0
Coal 0' 11 "	(Upper Freeport.. Coal)	7 9 123 9
Binder 0 1		
Bone coal.....1 1		
Coal 2 9½		
Binder 0 1½		
Coal 1 5½		
Binder 0 11		
Coal 0 4½		

Alfred (Rebecca) Carroll Core Test No. 14 (75).

Kingwood district, 1.4 miles N. 5° W. of Kingwood. Authority, Elkins Coal & Coke Co. Completed, 1906. Elevation, 1790' B-A. T.

	Thickness	Total
	Ft. In.	Ft. In.
Soil and clay.....	12 0	12 0
Fire clay	7 0	19 0
Sandstone, light, gray.....	8 0	27 0
Quartz conglomerate, hard and broken, partings of coal.....	4 0	31 0
Sandy shale and fire clay.....	5 0	36 0
Limestone, bastard	0 10	36 10
Sandstone, gray (Mahoning).....	45 2	82 0
Quartz conglomerate	5 6	87 6
Slate, black hard.....	0 7	88 1
Sandstone, gray	4 6	92 7
Quartz conglomerate	1 5	94 0
Sandstone, gray	4 0	98 0
Slate, black, (Uffington shale).....	11 0	109 0
Coal, (Upper Freeport).....	4 6	113 6
Slate, black	12 0	125 6
Limestone, dark (Upper Freeport).....	1 2	126 8
Fire clay and black sandstone.....	1 10	128 6
Fire clay and soapstone.....	10 6	139 0
Soapstone and shale	2 0	141 0
Fire clay, sandy.....	2 0	143 0
Sandstone, dark, to bottom.....	2 0	145 0

The foregoing bore holes in Kingwood district show the Upper Freeport coal present in good thickness. Only one—No. 74B, located 1.8 miles east of Manown station—tested the coals below the latter vein, and it did not quite reach down to the Lower Kittanning. This boring shows both the Lower Freeport and Upper Kittanning beds thinned down below minable thickness.

Reno District.

Seven coal test borings have been sunk within the boundaries of Reno, and three along the southern edge just across the line in Barbour county. The Survey was able to obtain the logs of all but three, the details of which follow herewith:

W. S. Jenkins Core Test (89).

Reno district, 0.8 mile northeast of Evansville. Authority. J. M. Guffey. Elevation, 1335' B- A. T.

	Thickness	Total
	Ft. In.	Ft. In.
Drift	14 9	14 9
Clay, plastic	5 0	19 9
Sandstone, pebbly....30' 1"	} Buffalo Sandstone..	80 9
Coal 0 1		
Sandstone, coarse....30 10		
Clay	0 10	81 7
Sandstone	0 6	82 1
Slate	1 0	83 1
Sandstone	0 3	83 4
Shale, calcareous.....	2 7	85 11
Slate, black	3 6	89 5
Slate, gray	10 5	99 10
Carbonaceous shale	1 1	100 11
Slate, gray	1 11	102 10
Coal, (Brush Creek).....	0 9	103 7
Fire clay	12 8	116 3
Slate, gray	1 6	117 9
Sandstone	3 6	121 3
Clay, ferriferous	6 0	127 3
Slate and sandstone	5 6	132 9
Sandstone	2 4	135 1
Shale, calcareous	7 10	142 11
Soapstone, talc or clay.....	8 9	151 8
Limestone	2 4	154 0
Shale, gray	13 8	167 8
Shale, calcareous	8 0	175 8
Shale	2 8	178 4
Shale, carboniferous (Upper Freeport coal horizon)	2 6	180 10
Fire clay	1 2	182 0
Shale, dark, sandy.....	8 4	190 4
Sandstone, with slate boulders.....	15 6	205 10
Slate, gray	5 6	211 4
Shale, calcareous	2 9	214 1
Limestone, bastard, (Upper Freeport)...	3 6	217 7
Shale, sandy	9 5	227 0
Shale, calcareous	10 2	237 2
Shale, sandy	16 4	253 6
Shale, sandy	9 10	263 4
Clay shale (soapstone).....	2 7	265 11
Sandstone	5 0	270 11

	Thickness	Total
	Ft. In.	Ft. In.
Slate, black	2 8	273 7
Coal, (Lower Freeport).....	1 0	274 7
Shale, dark	8 10	283 5
Shale, gray, sandy.....	19 4	302 9
Slate, black	2 0	304 9
Sandstone, gray, hard (water) (Lower Freeport, upper division).....	24 6	329 3
Slate, dark	0 11	330 2
Sandstone, gray	1 6	331 8
Slate, dark	1 4	333 0
Sandstone, gray, hard (Lower Freeport, lower division).....	20 6	353 6
Slate, dark	1 4	354 10
Sandstone, hard	1 0	355 10

According to Reger, the above boring starts 10 feet by hand-level below the Bakerstown coal. The Upper Freeport and Upper Kittanning coals are absent from the measures.

James Hamilton Coal Test (91).

Reno district, at Dent. Authority, J. M. Guffey. Elevation 1314' L-A. T.

	Thickness	Total
	Ft. In.	Ft. In.
Sand and clay.....	15 0	15 0
Shale, sandy	10 0	25 0
Sandstone	10 0	35 0
Sand shale	14 5	49 5
Slate	0 1	49 6
Coal 2' 5" }		
Binder 0 1 }		
Coal 2 2½ }		
Binder 0 2½ }		
Coal, dirty.....0 4½ }		
	(Upper Freeport)	
	(1258' L-A. T.)	
	5 3½	54 9½
Slate	0 2½	55 0
Shale, dark	10 0	65 0
Light sand shale	30 0	95 0
Shale, sandy	15 0	110 0
Sandstone	7 0	117 0
Shale, hard, dark.....	5 0	122 0
Light sandy shale	25 0	147 0
Dark sand shale	14 0	161 0
Shale, sandy	14 0	175 0
Sandstone (Lower Freeport, lower division)	77 7	252 7
Shale, dark	4 3½	256 10½
Sandstone, fine grained.....	1 6	258 4½
Sandstone, hard, coarse.....	13 6½	271 11
Coal, (Lower Kittanning).....	3 0½	274 11½
Dark, hard slate, shale to bottom.....	6 0½	281 0

The above boring starts 20 feet below the Brush Creek coal, and its log shows the absence of the Lower Freeport and Upper Kittanning coals.

James M. Hamilton Core Test (92).

Reno district, at Dent. Authority, J. M. Guffey. Elevation, 1325' L-A. T.

	Thickness		Total	
	Ft.	In.	Ft.	In.
Drift	12	0	12	0
Sandstone, sharp and fine (Lower Mahoning)	27	0	39	0
Slate	1	9	40	9
Coal 4' 1"	(1284' L-A. T.)		5	8
Binder 0 2				
Coal 1 5				
Fire clay	0	4	46	9

The above boring starts 200 feet below the Harlem coal.

James Lindsay Coal Test (94).

Cove district (Barbour), 0.9 mile northwest of Colebank, on Sandy creek. Authority, J. M. Guffey. Elevation, 1365' B-A. T.

	Thickness		Total	
	Ft.	In.	Ft.	In.
Clay and sand	5	0	5	0
Boulders and gravel.....	4	0	9	0
Shale, sandy	16	0	25	0
Shale, gray	11	0	36	0
Sandstone	4	0	40	0
Shale, dark	16	0	56	0
Sandstone	4	0	60	0
Fire clay (Thornton) and shale, gray, mixed	16	0	76	0
Shale, blue	4	0	80	0
Shale, soft gray, with lime spots.....	14	0	94	0
Shale, hard, gray, sandy.....	17	0	111	0
Sandstone, (Lower Mahoning).....	11	0	122	0
Shale, blue	18	0	140	0
Shale, dark gray.....	2	10	142	10
Shale, dark	0	2	143	0
Bone 0' 6"	(Upper Freeport).		2	7
Coal 2 1				
Fire clay (Bolivar).....	2	5	148	0
Sandstone, shaly, (Upper Freeport).....	20	0	168	0
Shale, gray	3	0	171	0
Shale, blue	19	6	190	6
Shale, dark	1	6	192	0
Fire clay shale.....	4	0	196	0
Shale, bluish	5	0	201	0
Shale, with gray partings.....	7	0	208	0

	Thickness	Total
	Ft. In.	Ft. In.
Limestone	1 0	209 0
Shale, gray, with lime spots.....	21 0	230 0
Shale, blue	4 6	234 6
Shale, with limestone.....	1 0	235 6
Shale, dark, with thin coal streaks, (Upper Kittanning)	2 6	238 0
Sandstone, coarse..... 4' } (Lower Free-		
Sandstone and conglomerate	43 0	281 0
Sandstone	10 } stone, lower	
Sandstone	29 } division)	
Shale, blue, tough.....	13 0	294 0
Shale, soft, gray, with hard sandstone boulders	5 0	299 0
Shale, blue	19 5	318 5
Coal	0' 5" } (Lower	
Binder	0 6 } Kittanning)	
Coal	0 3 }	
Fire clay nodules.....	0 5	320 0
Shale, gray.....	7 0	327 0
Shale, gray, with sandstone boulders.....	2 0	329 0
Sandstone, hard, broken, with carbon streaks, (Clarion)	36 0	365 0
Bone coal, (Clarion)	0 2	365 2
Sandstone, hard, with carbon streaks...13' 10" } (Homewood		
Conglomerate	6 0 } Sandstone)	
Sandstone	6 0 }	
Sandstone, fine grained	16 0 }	
Sandstone, micaceous, with carbon streaks	2 6 }	
Shale, dark.....	4 6	414 0
Shale, dark, tough.....	4 0	418 0
Shale, dark, sandy.....	7 0	425 0
Shale, sandy, with coal streaks.....	2 0	427 0
Shale, sandy.....	1 0	428 0

The above boring starts 116 feet by hand-level, according to Reger, below the Elk Lick coal, and penetrates the entire Allegheny series. Only the Upper Freeport is thick enough to be classed as minable, and it has thinned below its usual development.

Allie Rosier Coal Test (95).

Cove district, Barbour county, 0.2 mile west of Colebank. Authority, J. M. Guffey. Elevation, 1435' B-A. T.

	Thickness Ft. In.	Total Ft. In.
Surface, soil and loose shale 10.5'		
Conglomerate, with hard quartz pebbles..... 9.5	(Buffalo Sandstone)	46 0
Conglomerate 4.0		
Sandstone, coarse, broken 22.0		
Shale, gray	6 0	52 0
Fire clay shale	11 0	63 0
Shale, soft, gray, mixed with lime.....	20 0	83 0
Shale, sandy	9 0	92 0
Shale, gray (broken).....	8 6	100 6
Sandstone (Upper Mahoning).....	20 0	120 6
Shale, blue	0 10	121 4
Shale, dark	0 2	121 6
Shale, blue	0 6	122 0
Sandstone, coarse.....14'	(Lower Mahoning Sandstone)	25 0
Conglomerate, hard..... 5		
Sandstone, hard, white, with dark shale partings 6		
Shale, dark, gray.....	8 0	155 0
Shale, sand, with vein tracings.....	18 0	173 0
Shale, gray, sandy.....	12 0	185 0
Shale, dark, sandy.....	1 10	186 10
Bone coal 0' 2 "	(Upper Freeport). (1240' B.A. T.)	8 2
Coal 0 2		
Bone 0 6½		
Coal 1 1		
Binder 0 8½		
Coal 0 2		
Binder 0 3		
Coal and binder mixed 0 3		
Coal 0 4		
Fire clay binder.....0 4		
Coal (core lost).....0 6		
Shale 1 10		201 0
Coal 1 0		
Shale 0 1		
Coal 0 3		
Shale 0 1		
Coal 0 5		
Shale, sandy.....	6 0	203 0
Fire clay shale.....	2 0	203 0
Shale, sandy	10 0	213 0
Fire clay shale.....	2 5	215 5
Shale, sandy, with fire clay.....	18 0	233 5
Sandstone, (Upper Freeport).....	23 1	256 6
Fire clay shale.....	0 6	257 0

	Thickness Ft. In.	Total Ft. In.
Sandstone, coarse, (Lower Freeport , upper division)	30 0	287 0
Shale, dark, mixed with coal streaks (Upper Kittanning coal horizon).....	2 6	289 6
Shale, dark gray, to bottom.....	4 0	293 6

Marcellus Knotts Core Test (97A).

Reno district, 0.7 mile southeast of Fellowsville. Authority, J. M. Guffey. Elevation, 1410' B-A. T.

	Thickness Ft. In.	Total Ft. In.
Drift	20 0	20 0
Sandstone	6 7	26 7
Shale, dark, and slate.....	5 5	32 0
Coal 1' 7½"	7 6 (Upper Freeport). (1370' B-A. T.)	39 6
Slate 0 1½		
Coal 3 7		
Slate and fire clay...1 2½		
Bone 0 2½		
Coal 0 9		
Sand shale	3 0	42 6
Shale, limy	22 6	65 0
Fire clay	6 11	71 11
Shale, sandy	21 7	93 6
Sandstone (Lower Freeport , upper division)	62 2	155 8
Slate, black	1 4	157 0
Sandstone with carbon streaks 1' 1"	37 0 (Lower Freeport Sandstone lower division).	194 0
Sandstone, gray.....15 7		
Slate, black.....0 8		
Sandstone 19 8		
Shale, sandy	19 7	213 7
Sandstone, with carbon streaks.....	4 0	217 7
Slate, black	5 0	222 7
Sandstone	0 5	223 0
Coal, cannel, (Middle Kittanning).....	0 6	223 6
Sandstone, carbon streaks.....	0 9	224 3
Slate, black	6 9	231 0
Bone coal.....0' 4 "	4 10 (Lower Kittanning)	235 10
Coal 1 2		
Slate 0 3½		
Coal 3 0½		
Fire clay	6 2	242 0

The above boring starts 40 feet, aneroid measurement, below the Brush Creek coal, according to Hennen. The Lower Freeport and Upper Kittanning coals are not represented.



PLATE XXII.—Local tilting of upper Chemung strata near crest of Briery Mountain Anticline along E. & O. Ry., west of Salt Lick Falls near Terra Alta. Typical layers of hard thin sandstones and soft shale.

Photo by E. E. Knight

Austen Coal & Coke Co. Core Test No. 4 (88).

Reno district, 1.5 miles S. 15° W. of Austen. Authority, Austen Coal & Coke Co. Elevation, 1755' B-A. T.

	Thickness		Total	
	Ft.	In.	Ft.	In.
Surface	25	0	20	0
Shale, light, sandy.....	20	0	45	0
Shale, light	11	0	56	0
Shale, black	11	2	67	2
Coal (Harlem)	1	3	68	5
Fire clay and shale.....	10	0	78	5
Shale, light	8	0	86	5
Shale, variegated	12	0	98	5
Shale, light, sandy.....	10	7	109	0
Shale, light	10	0	119	0
Shale, light, sandy.....	9	0	128	0
Sand rock (Saltsburg).....	18	9	146	9
Shale, light	5	0	151	9
Coal, (Bakerstown).....	1	8	153	5
Fire clay	2	8	156	1
Lime (Albright) and shale.....	9	11	166	0
Shale, dark	6	0	172	0
Sand rock	24	0	196	0
Fire clay	11	0	207	0
Sand rock with hard spots (Buffalo).....	34	0	241	0
Sand rock and shale (Buffalo).....	4	0	245	0
Sand rock, hard (Buffalo).....	5	0	250	0
Soapstone and shale (Brush Creek).....	11	0	261	0
Bone coal (Brush Creek).....	0	2	261	2
Fire clay	5	0	266	2
Shale, light, sandy.....	6	0	272	2
Fire clay	3	0	275	2
Shale, light, sandy.....	15	4	290	6
Fire clay (Thornton)	6	0	296	6
Shale, light, sandy.....	4	0	300	6
Sand rock (Lower Mahoning).....	50	0	350	6
Slate and coal (Upper Freeport "rider")..	0	6	351	0
Slate	1	0	352	0
Coal	1	5	} (Upper Freeport.. Coal)	9
Slate	0	2 1/4		
Coal	1	7 1/2		
Slate	1	1		
Coal	1	0		
Slate	0	2		
Coal	0	3 1/4	}	1
Slate	0	4		
Fire clay	1	0		
Sand rock	5	0		
Shale, sandy	7	0		
Shale, dark	10	5		
Fire clay	3	6	385	0
Shale, sandy	15	0	400	0
Fire clay	5	0	405	0
Shale, sandy	13	0	418	0
Sand rock (Lower Freeport).....	72	0	490	0
Sand rock, with hard spots.....	7	0	497	0

	Thickness		Total
	Ft.	In.	Ft. in.
Sand rock, hard, (Lower Freeport).....	20	0	517 0
Hard sand rock and coal spars (Lower Freeport)	23	6	540 6
Hard sand rock and coal.....	2	0	542 6
Slate, black	1	6	544 0
Coal 1' 6"	4	8	548 8
Slate, black.....3 0			
Bone coal.....0 2			
Fire clay (Lower Kittanning).....	1	4	550 0
Soapstone	15	0	565 0
Sand rock to bottom	8	0	573 0

Portland District.

Seven coal test borings have been drilled in Portland district, of which the Survey was able to obtain the logs of only three. The records of Nos. 82 and 83 are published in connection with the Manheim section, page 94.

The other is located in the Mount Carmel Basin in the southeast corner of the district, the log of which follows herewith:

Oakland Coal & Coke Co. Core Test (84).

Portland district, 0.6 mile S. 15° W. of Corinth. Authority, Oakland Coal & Coke Co. Elevation 2520' B-A. T.

	Thickness	Total
	Feet.	Feet.
Unrecorded	134	134
Coal, (Lower Kittanning).....	7	141
Unrecorded	60	201
Coal (Clarion)	3	204
Unrecorded	83	287
Black slate	15	302
Coal 1' 0"	3	305
Slate, black.....0 10		
Coal 1 0		
Unrecorded	30	335
Sandstone, pebbly (Upper Connoquenessing)...	30	365

The above boring starts about 75 feet below the horizon of the Upper Freeport coal.

Union District.

The coal measures cover only a small portion of the area of Union district; viz, a small patch northeastward from Amboy, and a still smaller tract in the extreme southeastern point

of the district and county. In the latter region the Davis Coal & Coke Company sank two borings, one of which is in Union district, and the other in the edge of Garrett county, Md. Their logs follow herewith:

Fred Wotring Bore Hole No. 1 (103).

Union district, near Fairfax, and 2600' N. 41° 30' W. of Monument No. 1 in West Virginia-Maryland state line. Authority, Davis Coal & Coke Co. Elevation, 2900' B-A. T.

	Thickness		Total
	Ft.	In.	Ft. In.
Clay and boulders	6	0	6 0
Sandstone, coarse	8'		
Sandstone, with pebbles...3' } (Upper			
Freeport)	11	0	17 0
Shale, sticky	10	0	27 0
Shale, with sand bands.....	6	0	33 0
Shale, gray	9	0	42 0
Shale, dark	10	1	52 1
Coal, bony, (Lower Freeport).....	0	11	53 0
Shale, gray	11	0	64 0
Sandstone	2	0	66 0
Shale, gray	4	0	70 0
Shale, gray, soft, sticky	10	0	80 0
Shale, gray	29	0	109 0
Sandstone, hard, (Lower Freeport).....	36	0	145 0
Shale, dark gray.....	5	0	150 0
Shale, dark	5	4	155 4
Slate, black	0	8	156 0
Coal 1' 1" } (Middle and Low-			
Slate, black.....4 0 } er Kittanning..			
Bone coal 0 1 } Coals).	15	8	171 8
Coal 2 1 } (2745' B-A. T.)			
Slate, gray.....0 2 }			
Coal 3 2 }			
Slate, gray.....1 10 }			
Coal 3 3 }			
Shale, gray, sticky.....	4	4	176 0

Wilson Bore Hole No. 3 (104).

In Garrett county, Md., near Fairfax, on north bank of Potomac river, 250' east of Monument No. 1 on West Virginia-Maryland state line. Authority, Davis Coal & Coke Co. Elevation, 2720' B-A. T.

	Thickness		Total
	Ft.	In.	Ft. In.
Clay and boulders.....	6	0	6 0
Shale, soft	3	0	9 0
Shale, sandy	12	0	21 0
Shale, blue, sandy.....	22	0	43 0
Shale, soft, dark.....	4	0	47 0
Limestone	6	0	53 0
Shale, red	2	0	55 0
Shale, blue, sandy.....	25	0	80 0

	Thickness		Total	
	Ft.	In.	Ft.	In.
Sandstone	12	0	92	0
Shale, dark (Upper Freeport coal horizon)	8	0	100	0
Shale, gray, with limestone (Upper Free-				
port limestone)	4	0	104	0
Shale, blue	43	0	147	0
Sandstone	9	0	156	0
Shale, red	7	0	163	0
Shale, blue	17	0	180	0
Shale, dark	11	4	191	4
Bone coal (Lower Freeport)	1	8	193	0
Shale, gray	7	0	200	0
Sandstone	4	0	204	0
Shale, gray, sandy	24	0	228	0
Sandstone	9	0	237	0
Shale, blue	7	0	244	0
Shale, gray, mixed with lime	22	0	266	0
Sandstone, hard	2	0	268	0
Sandstone	10	0	278	0
Shale, gray, sandy	11	0	289	0
Shale, dark	4	0	293	0
Shale, gray	4	0	297	0
Shale, dark	3	0	300	0
Shale, dark, with coal partings	1	9	301	9
Coal 1' 2 " }				
Shale, dark...4 11 }				
Coal 2 7½ }				
Slate binder...0 2½ }				
Coal 3 1 }				
Slate binder...1 3 }				
Coal 4 7 }				
Shale, gray, to bottom	3	8	323	3

(Middle and Lower
Kittanning...
Coals).

The thick coal near the bottom of each boring apparently represents the Middle and Lower Kittanning beds combined, as happens at the Newburg shaft. Bore Hole No. 104 starts 540 to 550 feet below the Pittsburgh coal horizon, as measured by Hennen with aneroid and corrected for rapid southeast dip of the strata, the latter, as determined from the two above logs, amounting to 600 feet to the mile. The Upper Freeport and Upper Kittanning coals have locally thinned away, since both are represented at other points in the Potomac Basin.

MINABLE COALS.

In this county there are apparently 10 workable coals in addition to 8 to 10 other veins that are too thin, impure and irregular to be so classed. The probable minable beds in descending order are the Pittsburgh in the Monongahela series;

Elk Lick, Harlem and Bakerstown in the Conemaugh; Upper Freeport, Lower Freeport, Upper Kittanning, Lower Kittanning and Clarion in the Allegheny; and the Quakertown in the Pottsville.

The analyses and calorific results published herein were determined by J. Berghius Krak and former Assistant Chemists of the Survey, under the supervision of B. H. Hite, Chief Chemist. Practically the same methods of collecting samples and making analyses were employed as obtain in the Fuel Testing Department of the Bureau of Mines at Washington, D. C., the calorific results being expressed in terms of British Thermal Units (B. T. U.), this unit of heat measurement representing the amount of heat required to raise one pound of water one degree Fahrenheit in temperature. In addition to both proximate and ultimate analyses, and calorific tests, the table at the end of this chapter gives the **ratio** of the **total carbon** to the **oxygen plus ash**, the latter classifying the coals closely in the order of their relative rank as to heat value.

The minable coals will now be discussed by series in descending order.

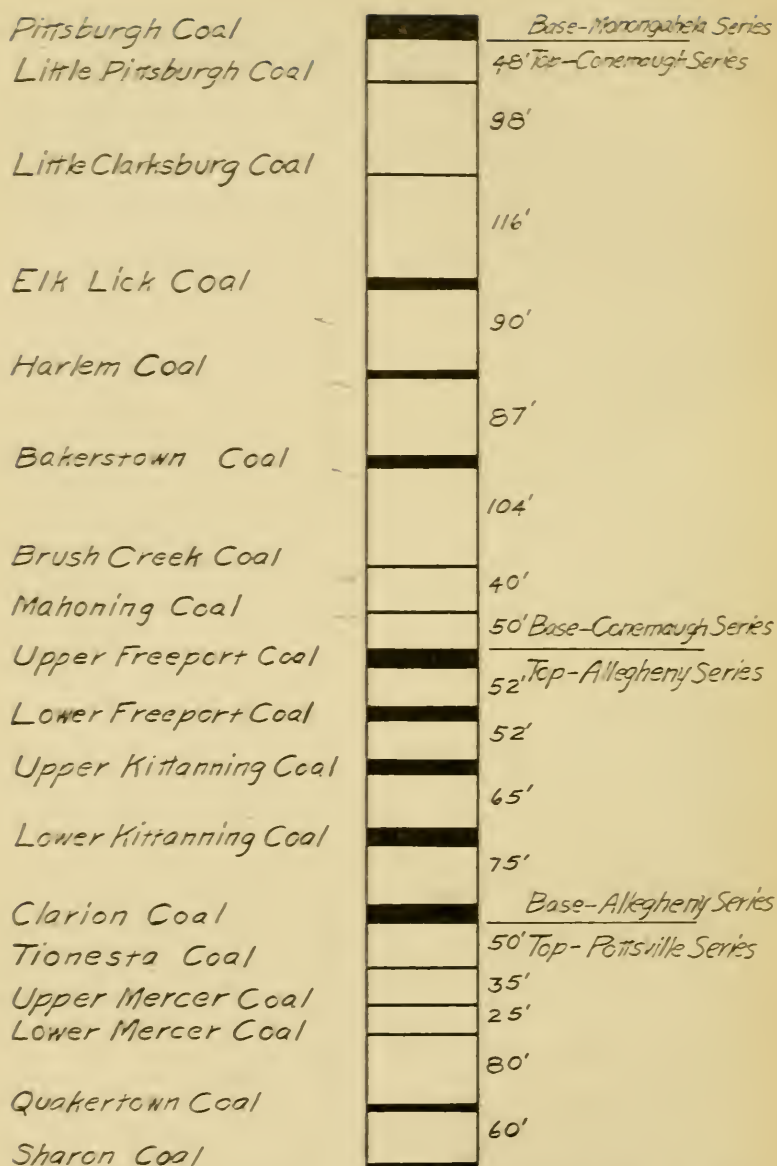


Figure 3.—Showing relative position of Coal Veins in Preston County.
Those represented by light lines are not minable.

MINABLE COALS OF THE MONONGAHELA SERIES.

The Pittsburgh Coal.

The Pittsburgh is the only bed to attain minable thickness, purity and regularity in the Monongahela series that is left uneroded in Preston county. Its crop is shown by an appropriate symbol on Map II. Its thickness, character and distribution have already been described in Chapter V. pages 107-111.



Figure 4.—Showing total area of Pittsburgh Coal—mostly mined out.

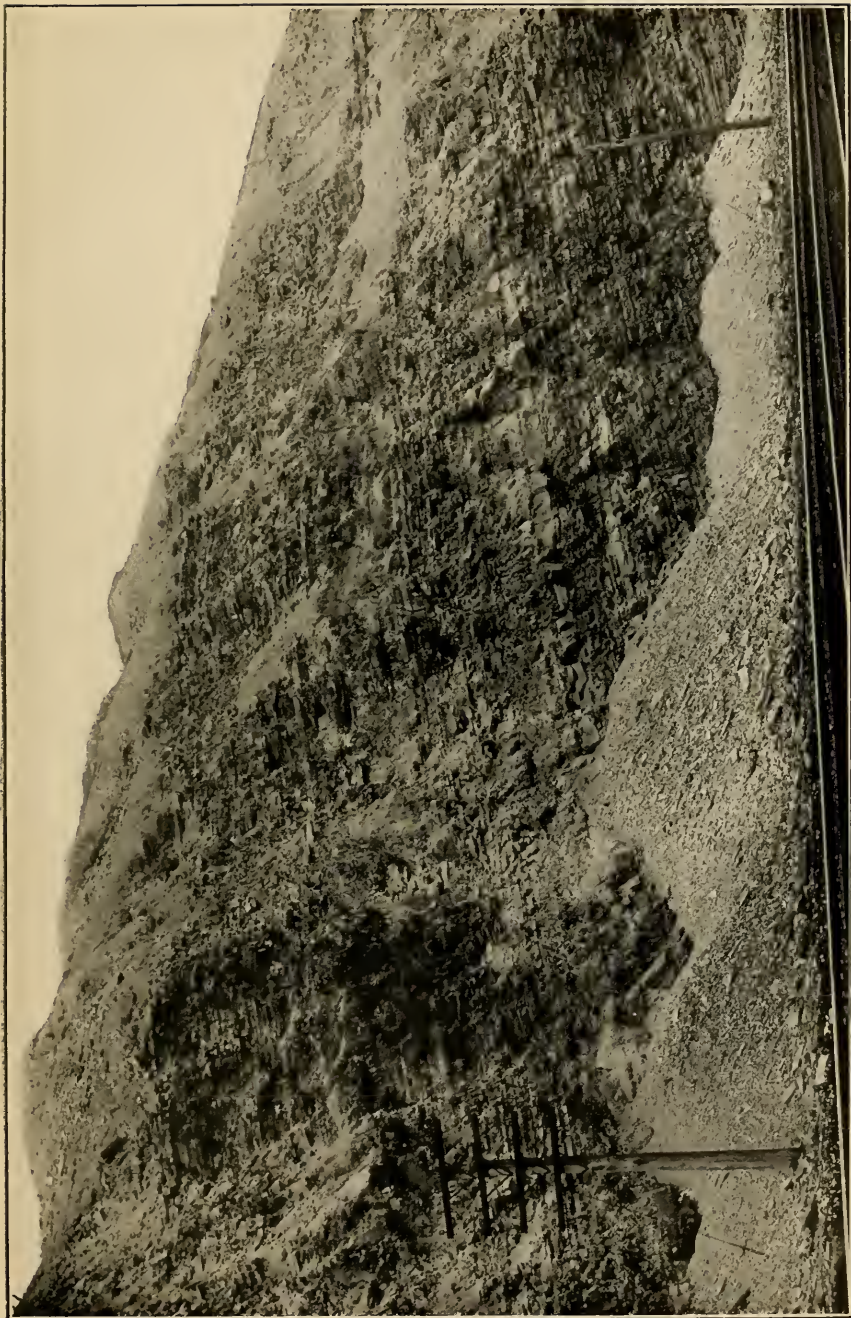


PLATE XXIII.—Showing alternate layers of hard thin sandstone and soft shale of the Chemung in the B. & O. Ry. cut, $\frac{3}{4}$ mile N.E. of Rodemer, Photo by E. E. Knight

Quantity of Pittsburgh Coal Available.

As mentioned in Chapter V the major portion of the Pittsburgh bed that was left uneroded has already been mined, but from the data therein it is safe to assume an average thickness of **10 feet** for this vein spread out over the entire area of the seam as shown on Map II, in forming an estimate of available coal before mining operations were begun. A careful measurement of this area on Map II with planimeter by Reger gives the following results:

Available Pittsburgh Coal Previous to Mining Operations.

District	Square Miles	Acres	Cubic Feet of Coal	Short Tons of Coal
Kingwood	0.065	41.6	18,120,960	724,838
Lyon	1.49	953.6	415,388,160	16,615,526
Reno	0.10	64.0	27,878,400	1,115,136
Totals	1.655	1,059.2	461,387,520	18,455,500

In arriving at the above results a weight of 80 pounds to the cubic foot of coal was assumed, or at the rate of 25 cubic feet to the short ton. These figures obtained at the Fuel Testing plants of the Federal Bureau of Mines for the same amount of Pittsburgh coal.

Probably 80 per cent of the above tonnage estimate has already been mined or lost by fire. Hence it is probable that not more than **3,500,000 short tons** of Pittsburgh coal remain unmined in Preston county.

MINABLE COALS OF THE CONEMAUGH SERIES.

The apparent minable coals of the Conemaugh series in Preston county are the Elk Lick, Harlem and Bakerstown. These will now be discussed in descending order.

The Elk Lick Coal.

The Elk Lick is the highest bed to attain workable dimensions and purity in Preston. Its thickness, composition and distribution have already been discussed in Chapter VI, pages 120-123.

Quantity of Elk Lick Coal Available.

The crop of the Elk Lick coal should follow roughly the same areas as outlined on Map II for the Bakerstown, belonging as it does about 200 feet above the latter seam. The minable area is mostly confined to the Ligonier and Evansville Basins in Valley, Lyon and Reno districts, and probably does not exceed 30 square miles—19,200 acres. In forming an estimate of the available tonnage, an average thickness of 2 feet spread out over the latter area appears conservative. Figuring on this basis, there should be about 67,000,000 short tons.

The Harlem Coal.

The Harlem is apparently the next minable bed in descending order in the Conemaugh measures of Preston. Its thickness, composition and distribution have been discussed in Chapter VI, pages 128-131. The crop of this vein is confined to practically the same areas as that outlined for the Bakerstown coal, coming as it does only 100 feet above the latter seam.

Quantity of Harlem Coal Available.

In forming an estimate of the area of the Harlem coal, it is believed that the tabulated results for the Bakerstown bed on a subsequent page, multiplied by 50 per cent, in every instance will give a close approximation. Figuring on this basis, the total for the county is 42,375 square miles—26,620 acres. Assuming an average thickness of 1 foot spread out over the latter area, the total available Harlem coal for Preston is about 47,250,000 short tons.

The Bakerstown Coal.

The Bakerstown is the lowest minable coal in the Conemaugh measures of Preston. The accompanying figure exhibits at a glance the area of this bed that is left uneroded, and shows the same to be confined to the Ligonier, Evansville and Kingwood Basins. The thickness, character, composition and distribution of this vein have been described in detail in Chapter VI, pages 133-139. Additional data on this coal are given on preceding pages of this chapter in logs of Bore Holes Nos. 31, 32, 37, 53 and 88 on Map II.



Figure 5.—Showing total area of Bakerston Coal, over the most of which the bed is minable. (See Text).

Quantity of Bakerstown Coal Available.

From all data obtainable it is quite evident that an average thickness of **2 feet** spread out over the entire area of this bed as outlined on Map II is conservative in forming an estimate of available tonnage. This thickness in conjunction with a planimetric determination of district areas by Reger gives the following results:

District	Square Miles	Acres	Cubic Feet of Coal	Short Tons of Coal
Grant	1.26	805	70,131,600	2,805,264
Pleasant	5.05	3,230	281,397,600	11,255,904
Valley	6.75	4,320	376,358,400	15,054,336
Lyon	24.29	15,545	1,354,280,400	54,171,216
Kingwood	13.81	8,840	770,140,800	30,805,632
Portland	5.49	3,515	306,226,800	12,249,072
Reno	28.10	17,985	1,566,853,200	62,674,128
Totals	84.75	54,240	4,725,388,800	189,045,552

Owing to the presence within Preston county of thicker, purer and more easily accessible Allegheny coals, the three foregoing beds in the Conemaugh are not now marketable. When the better coals approach exhaustion, then these poorer grades will no doubt be utilized for both heat and power.

MINABLE COALS OF THE ALLEGHENY SERIES.

There are five apparent minable coals in the Allegheny series of Preston; viz, Upper Freeport, Lower Freeport, Upper Kittanning, Lower Kittanning and Clarion. These will now be discussed in descending order..

The Upper Freeport Coal.

The Upper Freeport, described briefly in Chapter VII, is the most extensively mined coal in the county. Its uniformly low sulphur and comparatively low ash content make it unusually valuable for coking purposes, especially the "main bench" and "mining ply" portions of the vein. The area of the bed is exhibited on Figure 6 and its detailed crop by appropriate symbol on Map II. Numerous sections were measured

and samples collected both at country banks and commercial mines, all of which will now be discussed by districts.

Grant District.

The Upper Freeport coal attains a fine development in Grant district, especially in the western half. The following section was measured by Hennen at the **A. M. Myers opening** along the west bank of Hazel run, 0.5 mile northeast of Florence:

			Ft.	In.
Slate, black, roof.....				
Coal soft.....	2'	6 "	}	4 9½
Slate, gray	0	2		
Coal, soft.....	0	10		
Slate, gray.....	0	0½		
Coal	0	3	}	1 0
Slate, gray, to pavement.....				
Elevation of coal, 1775' A. T., aneroid measurement.				



Figure 6.—Showing total area of the Upper Freeport Coal over the most of which the bed is minable. (See description by magisterial districts in text).

A sample for analysis was collected and the following section measured by Reger at a country bank in this coal along the west side of Hazel run, 0.5 mile southeast of Florence:

Henry Allen Mine, Upper Freeport Coal, No. 13 on Map II.

		Ft.	In.
1. Sandstone, massive, Mahoning.....		35	0
2. Coal, soft.....	1' 4"	7	5
3. Coal, bony	0 4		
4. Coal, soft	2 10		
5. Shale, gray	0 2		
6. Coal, soft	1 6		
7. Shale, gray	0 5	10	10
8. Coal hard, bony.....	0 10		
9. Shale			
Elevation, 1740' A. T., aneroid.			

The composition of the sample from Nos. 2, 4 and 6 only of section, as reported by Messrs. Hite and Krak, is found under **No. 13** in the table of coal analyses at the end of this chapter. The sample is unusually high in sulphur, which is no doubt caused by the inclusion of the "roof coal," or formation No. 2.

Passing southwestward in the same district, 3 miles, the following section was obtained by Reger at the **M. H. King mine**, located near the end of the private road, 0.7 mile northwest of Laurel Church:

		Ft.	In.
Sandstone, shaly, Mahoning.....		12	0
Coal, hard, bony.....	2' 4"	6	9
Coal, soft	3 1		
Slate, gray	0 2		
Coal, soft	1 2		
Shale			
Elevation of coal, 1870' A. T., aneroid measurement.			

The above opening reveals a good thickness of the "roof coal" division of this vein, which is usually higher in sulphur and phosphorus than the "main bench" and "mining ply."

The following section was measured near the axis of the Ligonier Basin at the **William Speelman mine**, located 1.6 miles N. 20° W. of Hopewell Church:

		Ft.	In.
Sandstone, massive			
Slate, black.....		0	2
Coal, soft, with shale streaks..3' 5"	}	4	9
Slate, gray			
Coal, soft			
Slate pavement			

Elevation of coal, 1690' A. T., aneroid measurement.

The following section was measured by Hennen at the **T. M. King mine**, located $1\frac{1}{4}$ miles southwest of Hopewell Church:

		Ft.	In.
Sandstone, Mahoning		10	0
Slate, black, Uffington.....		0	6
Coal, bony.....0' 7 "	} Upper Freeport....	4	10
Coal, soft			
Slate, gray			
Coal, soft			
Slate, gray			
Coal			
Slate pavement			

Elevation of coal, 1685' A. T., aneroid measurement.

The following section was measured by Reger at an opening in the Upper Freeport along the west hillside of Big Sandy creek, 0.4 miles northward from Rockville:

		Ft.	In.
Fire clay			
Coal, bony	}	3	3
Coal, soft			
Slate			
Coal			
Shale			

Elevation of coal, 1655' A. T., aneroid measurement.

The above opening is near the southwestern point of the thin Upper Freeport coal area of eastern Grant district.

In the western edge of Grant district, a sample for analysis was collected and the following data obtained by Hennen¹ at a mine in the Upper Freeport coal, 0.5 mile south of Pisgah:

¹Vol. II(a), W. Va., Geol. Survey, p. 597; 1908.



PLATE XXIV.—Showing ripple marks and mud cracks on sandstone flag from Chemung Series near Rowlesburg. Photo by E. E. Knight

A. F. Walls Mine.—No. 15 on Map II.

				Ft.	In.
1.	Slate roof	.....			
2.	Coal, good	2' 8	"		
3.	Slate	0 2			
4.	Coal	0 10			
5.	Slate and shale	1 8			
6.	Coal	0 6	}	7	0½
7.	Slate	0 0½			
8.	Coal	0 4			
9.	Slate	0 2			
10.	Coal	0 8			
Elevation of coal, 2060' A. T., aneroid measurement.					

The sample was taken down across working face, omitting Nos. 1, 3, 5 and 9 of section, the composition of which as reported by Messrs. Hite, Patton and Forkum is found under **No. 15** in the table of coal analyses at the end of this chapter. The results show the coal high in both ash and sulphur, due largely to the inclusion in the sample of Nos. 6, 8 and 10.

The following data by Hennen in a modified form are taken from a page (598) of Volume II(a) of the State Geological Reports:

L. Birtcher Mine.—No. 16 on Map II.

Located 2.4 miles S. 15° E. of Pisgah. **Upper Freeport Coal.**

		Ft.	In.
1.	Soft shale roof.....		
2.	Coal, hard, some bone.....	1' 3 "	
3.	Bone	0 0½	
4.	Coal	3 4	
5.	Shale	0 1½	
6.	Coal	1 1	5 10
7.	Slate floor		
Elevation of coal, 1660' A. T., aneroid measurement.			

The sample was collected back at the working face, the composition of which, as reported by Messrs. Hite, Patton and Forkum, is found under **No. 16** in the table of coal analyses at the end of this chapter.

Passing to the north central portion of Grant district, the following section was measured at the **Waitman Maust mine** in what appears to be Upper Freeport coal, located 2.7 miles northwest of Clifton Mills, nearly on the axis of the Ligonier Basin:

	Ft.	In.
Sandstone, Mahoning		
Coal 1' 3"	2	7
Slate, black, sulphurous.....0 1		
Coal 1 3		
Slate, black, and concealed by water.....		
Elevation of coal, 1640' A. T., aneroid measurement.		

It is barely possible that the above may represent the Lower Freeport, since the section is not typical of the Upper bed.

Eastward 6 miles in the same district, it is this coal that was once opened at the road fork, 0.5 mile southwest of Five Forks, at an elevation of 2160' A. T., aneroid measurement. When visited during 1912, the mine had fallen shut so that a section could not be obtained.

In the same region a sample for analysis was collected and the following data obtained by Reger at a country bank:

D. W. Glover Mine.—No. 14 on Map II.

Located 1.5 miles S. 15° W. of Five Forks.		Upper Freeport Coal.	
		Ft.	In.
1. Slate, black			
2. Coal, soft	1' 10"		
3. Slate, black	0 1		
4. Coal, soft	1 6		
5. Slate, black	0 1		
6. Coal, soft	0 9	4	3
7. Slate, gray			
Elevation of coal, 2100' A. T., aneroid measurement.			

The composition of the sample from Nos. 2, 4 and 6 only of section, as reported by Messrs. Hite and Krak, is found under **No. 14** in the table of analyses at the end of this chapter. The results show the bed in this region very low in sulphur and comparatively low in ash, but with a fairly high phosphorus content.

In the northeastern corner of Grant district the following section was measured by Reger at the **David Dennis mine** in the Upper Freeport seam, located on the east hillside of Feik run, $\frac{3}{4}$ mile northeast of Glade Farms:

	Ft.	In.
Slate, black.....		
Coal, soft	1' 7"	
Slate, black	1" to 0	2

		Ft.	In.
Coal, soft	1' 5"		
Shale, gray	0 1		
Coal	0 7	3	10

Shale, gray

Elevation of coal, 2100' A. T., aneroid measurement.

In the same region it is this vein that is being mined on the **Albert Robinson** and **Truman Frazee** farms. The following section was measured by Hennen at the **Frazee** opening, located nearly on the crest of the Briery Mountain anticline, 1.2 miles southeast of Glade Farms:

		Ft.	In.
Slate			
Coal, sulphurous and soft...	0' 5"		
Slate, black	0 1		
Coal, soft	2 0		
Slate, black	0 1		
Coal, soft	1 5	Upper	
Slate, black	0 1	Freeport....	4 6
Coal, bony, sulphurous....	0 5		

Slate

Elevation of coal, 2170' A. T., aneroid measurement.

Passing southwestward in the same district to the Kingwood Basin, the following section was obtained at the **L. E. Frankhouser** mine:

		Ft.	In.
Sandstone, massive, Mahoning.....			
Slate black		0	0½
Coal, soft	2' 0"	Upper	
Coal, hard	0 3	Freeport	
Slate, black	0 1	Coal	
Coal, soft	1 6		3 10

Slate

Elevation of coal, 1665' A. T., aneroid measurement.

In the same district, the following section was measured at the **A. L. Benson** mine, located along the north hillside of Little Sandy creek, ¾ mile southeast of Hopewell Church:

		Ft.	In.
Shale			
Coal, soft	0' 7"		
Shale, gray and black.....	0 6		
Bone	0 4		
Coal, soft columnar.....	1 5		
Slate, black	0 1	Upper	
Coal, soft	1 3	Freeport....	4 2

Shale, gray, pavement.....

Elevation of coal, 1680' A. T., aneroid measurement.

The last five sections from the northern portion of Grant district show the Upper Freeport about a foot less in thickness than its usual development in eastern Monongalia and western Preston, all the thinning having taken place in the "main bench" as this vein is divided in Chapter V.

It appears to be this bed that was once opened at the **John Frankhouser mine**, located along the east hillside of Barnes run, $1\frac{3}{4}$ miles southeast of Brandonville, at an elevation of 1885' A. T., aneroid measurement. This bank had fallen shut when visited by Hennen in 1912, but Mr. Frankhouser reports the coal about 30 inches thick.

Passing to the southeastern edge of Grant district, the following section was measured by Hennen at the **Samuel Moyers bank**, located a short distance south of the public road, 1.8 miles west of Hazelton:

		Ft.	In.
Sandstone, Mahoning			
Slate, sandy		1	2
Coal, bony 0'	8 "		
Slate, black 0	2		
Coal, soft 1	8		
Slate, black 0	1½		
Coal, soft 0	5		
Slate, black 0	1	Upper	
Coal, bony 0	6	Freeport Coal	3
			7½

Slate pavement

Elevation of coal, 1915' A. T., aneroid measurement.

About a mile and a half eastward the coal attains its normal development as revealed in the following section measured at the **A. F. Herring opening**, located along the north hillside of Little Sandy creek, 0.7 mile northwest of Hazelton:

		Ft.	In.
Shale		1	0
Coal, soft 3'	2 "		
Slate, black 0	1½		
Coal 1	4	4	7½

Concealed by water

Elevation of coal, 1914' A. T., spirit level measurement.

According to Hennen the above mine is 30 feet by hand-level above an opening in the Lower Freeport coal.

From the foregoing data in Grant district, it is quite evident that the Upper Freeport coal will not much exceed $3\frac{1}{2}$

to 4 feet in thickness in all that portion east of the axis of the Preston anticline as outlined on Map II.

Pleasant District.

Pleasant district lies immediately south of Grant, but within its boundaries the Upper Freeport coal attains a fine development. As in the latter area the chief source of information as to its thickness and character has been the numerous country banks opened along its crop, since there are no commercial mines therein, due wholly to lack of transportation facilities. In the southern portion of the district the logs of Bore Holes Nos. 27A, 28, 29, 30, 31 and 32, published on preceding pages of this chapter, give valuable information for this bed where it lies below drainage. Several sections will now be given throughout the district.

In the eastern point of the district the following section was measured by Hennen at the **James Radabaugh mine**, 0.3 mile southeast of the mouth of Big Sandy creek:

		Ft.	In.
Sandstone, Mahoning			
Shale, Uffington		0	6
Coal	1' 2 "		
Slate	0 1		
Coal, bony	0 2½		
Coal, soft	2 10	Upper Freeport	
Slate, gray	0 1½		
Coal, soft.....	1 1	5	6
Slate			
Elevation of coal, 1645' A. T., aneroid measurement .			

The following section was obtained by Hennen at the **Wilbur Smith bank**, located on the east edge of the public road leading north to Little Sandy creek, 2.4 miles east of Rockville:

			Ft.	In.
Sandstone massive, Mahoning.....			4	0
Shale, dark, gray, Uffington			0	4
Coal, soft	2' 0 "			
Coal, harder.....	0 4			
Slate, gray	0 1½	Upper		
Coal, soft	1 0	Freeport....	3	5½
Concealed, by water				
Elevation of coal, 1765' A. T., aneroid measurement.				

One mile and a half eastward, the following section of this coal for the northern edge of Pleasant district is reported by Staley Liston at the **Benjamin Liston bank**, located $\frac{3}{4}$ mile northwest of Morgans Glade, the opening having fallen shut when visited by Hennen during 1912:

			Ft.	In.
Slate				
Coal, soft	4'	0"	Upper	
Slate, black.....	0	10	Freeport	
Coal, hard, bony.....	3	0		7 10

Slate

Elevation of coal, 1720' A. T., aneroid measurement.

One-half mile southwestward it is the Upper Freeport coal that was once opened on the **Staley Liston farm** at an elevation of 1730' A. T., aneroid measurement, 50 feet above another mine on the same farm in the Lower Freeport vein. The former had fallen shut when visited by Hennen, so that it was not possible to obtain a section, but it is important in that it helps to determine the correlation of the thick coal mined here 50 feet lower, a feature that has caused considerable dispute among mining engineers and geologists engaged in the investigation of the coal fields of northern Preston county.

Passing eastward along the northern edge of Pleasant district, the following section was measured by Hennen at the **Clayton Glover bank**, located on the east edge of the public road leading north and south, 0.5 mile west of Hazelton, where the Upper Freeport coal is in normal development:

			Ft.	In.
Slate				
Coal	1'	4"		
Coal, bony	0	6		
Coal, soft	2	6		
Slate, gray.....	$\frac{1}{2}$ "	to 0	2	Upper
Coal soft	18"	to 1	8	Freeport
Slate	1"	to 0	2	Coal
Coal, harder	0	5		6 9

Slate

Elevation of coal, 1975' A. T., aneroid measurement.

Four and a half miles southward in Pleasant, the following section of this coal was obtained along the southeast edge of the Upper Freeport field of this district, at the **Samuel Feather bank**, $\frac{1}{4}$ mile northeast of Cuzzart:

			Ft.	In.
Coal, soft	2'	4"		
Slate, gray	0	2	Upper	
Coal	1	4	Freeport	
Slate, gray	0	2	Coal	
Coal	7" to 0	11	4	11

Slate, gray, pavement.....

Elevation of coal, 2180' A. T., aneroid measurement.

Five miles westward a sample for analysis was collected by Hennen and the following information in a modified form, as published on pages 607-608 of Volume II(a) of the State Survey Reports, was obtained:

Raymond Bishop Mine.—No. 17 on Map II.

Located 1.8 miles N. W. of Valleypoint; **Upper Freeport Coal.**

			Ft.	In.
1. Shale, visible			3	0
2. Coal	1'	7 "		
3. Bone	0	0½		
4. Coal	0	8½		
5. Slate	0	2½		
6. Coal	1	4	3	10½

7. Fire clay

Elevation of coal, 1830' A. T., aneroid measurement.

The composition of the sample, as reported by Messrs. Hite, Patton and Forkum, is found under **No. 17** in the table of coal analyses at the end of this chapter. The results show this coal about 5 per cent lower in volatile matter and slightly higher in fixed carbon and ash than in the Bretz region of Valley district.

Near the crest of the Preston anticline, a sample of this coal for analysis was collected by Hennen and the following information in a modified form, as published on page 608 of Volume II(a) of the State Survey Reports, was obtained:

Harrison Cale Mine.—No. 18 on Map II.

Located 1.7 miles west of Valleypoint. **Upper Freeport Coal.**

			Ft.	In.
Shale				
Coal, soft	2'	8"		
Slate	0	2		
Coal	1	1		
Fire clay, hard.....	1	0		

			Ft.	In.
Coal, bony	0'	8"		
Coal, soft	0	4	5	11

Shale

Elevation of coal, 2020' A. T., aneroid measurement.

The composition of the sample, as reported by Messrs. Hite, Patton and Forkum, is given under **No. 18** in the table of coal analyses at the end of this chapter. The results show the coal comparing favorably in both sulphur and ash content with the same bed in the Bretz region of Preston county, where the "main bench" and "mining ply" are specially adapted to the manufacture of by-product coke.

About one mile northwest of the above mine, the same bed was once mined on the **David Graham farm**, at an elevation of 2020' A. T., aneroid measurement. This opening had fallen shut when visited in 1906.

The following information in a modified form, as published on page 602 of the above mentioned report, was obtained by Hennen at a mine on the head of Glade run, 0.6 mile northward from Valleypoint:

Jehu Liston Mine.—No. 19 on Map II.

			Ft.	In.
1. Coal, trace				
2. Shale gray			2	6
3. Slate, soft			0	3
4. Coal	0'	4 "		
5. Slate, gray	0	3		
6. Coal, soft	3	1	Upper Freeport	
7. Slate	0	1¾		
8. Coal, soft	1	0	4	9¾

9. Slate

Elevation of coal, 1900' A. T., aneroid measurement.

The composition of the sample, as reported by Messrs. Hite, Patton and Forkum, is given under **No. 19** in the table of coal analyses at the end of this chapter.

The information at the seven following country banks on the Upper Freeport coal in Pleasant district was obtained by Hennen and was published on pages 603, 601, 601, 602, 607, 607 and 606, respectively, of Volume II(a) of the State Geological Survey Reports:

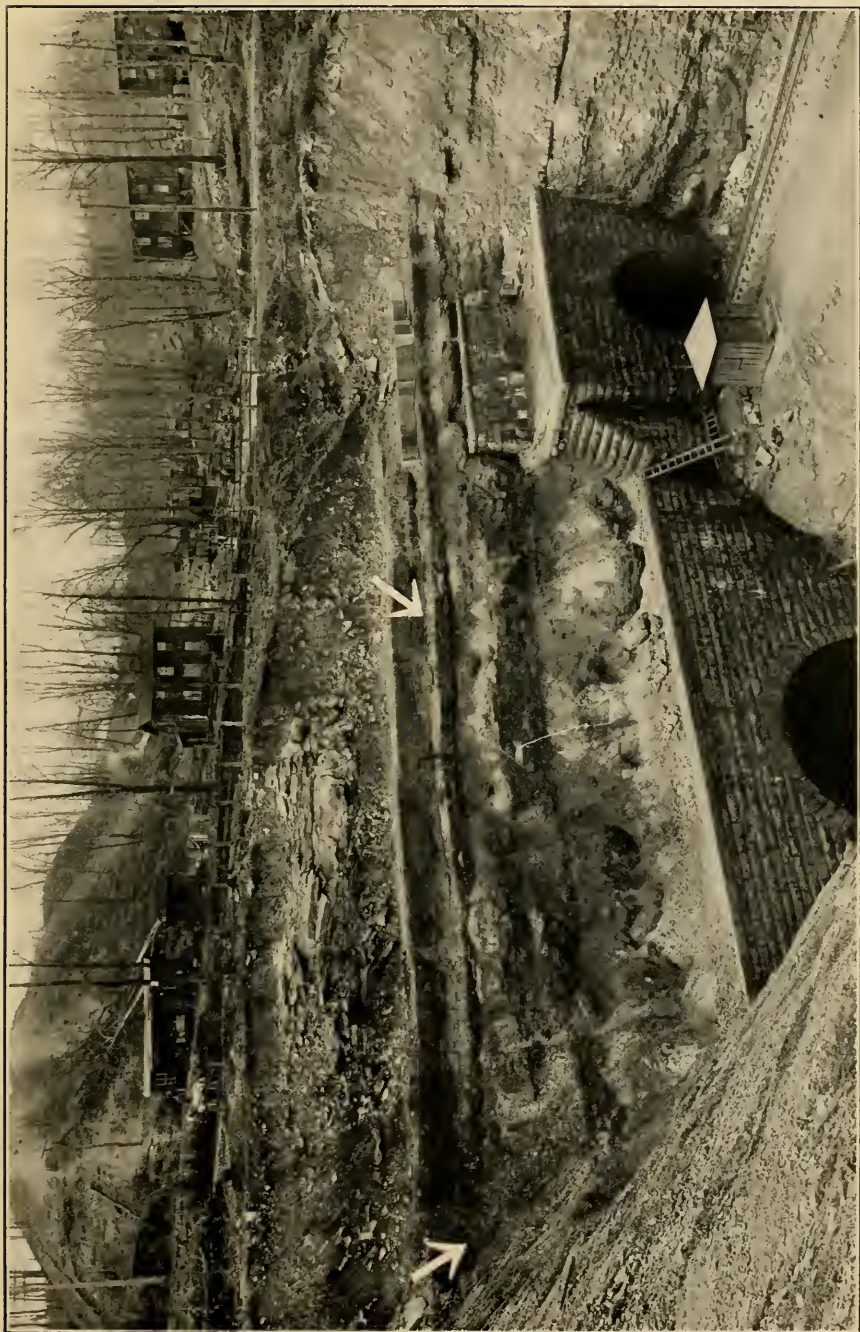


PLATE XXV.—Eastern portals of the Kingwood tunnels of the B. & O. Ry. at Tunnelton. The Upper Freeport Coal cropping at white arrows. (See Text).

Photo by E. E. Knight

Joseph Smith Mine.—No. 20 on Map II.

Located 1.3 miles east of Valleypoint. **Upper Freeport Coal.**

			Ft.	In.
1. Slate				
2. Coal, soft	3'	2"		
3. Slate, gray.....	0	1		
4. Coal, soft	1	2	4	5
5. Slate				

Elevation of coal, 1800' A. T., aneroid measurement.

The coal is about 25 feet above an opening in the Lower Freeport vein.

For analysis of sample collected from the above mine, as reported by Messrs. Hite, Patton and Forkum, see **No. 20** in the table of analyses at the end of this chapter.

Newton Martin Mine.—No. 21 on Map II.

Located in a ravine at the west end of Valleypoint. **Upper Freeport Coal.**

			Ft.	In.
Sandstone, massive, Mahoning.....				
Shale, Uffington			6	0
Coal, bony	0'	6 "		
Slate	0	1½		
Coal, good	3	1		
Slate, hard	0	1		
Coal, good	1	1	4	10½

Slate and concealed.....

Elevation of coal, 1875' A. T., aneroid measurement.

The composition of the sample, as reported by Messrs. Hite and Patton, is given under **No. 21** in the table of coal analyses at the end of this chapter.

McClellan Hartman Mine.—No. 22 on Map II.

Located one-fourth mile southeast of Valleypoint. **Upper Freeport Coal.**

			Ft.	In.
Coal, bony, roof, thickness concealed.....				
Coal, soft	3'	0"		
Bone	0	2		
Coal, soft	1	0	4	2

Slate

Elevation of coal, 1850' A. T., aneroid measurement.

For the analysis of the sample from the Hartman mine, as reported by Messrs. Hite and Patton, see **No. 22** in the table of coal analyses at the end of this chapter.

J. W. Jackson Mine.—No. 23 on Map II.

Located one-half mile southeast of Valleypoint. **Upper Freeport Coal.**

			Ft.	In.
Slate roof				
Coal, soft	3'	2 "		
Slate	0	1½		
Coal, soft	0	11		
Slate, hard	0	1½		
Coal	0	3	4	6

Fire clay

Elevation of coal, 1820' A. T., aneroid measurement.

For analysis of sample from above mine, as reported by Messrs. Hite and Patton, see **No. 23** in the table of analyses at the end of this chapter.

Jackson Martin Mine.—No. 24 on Map II.

Located on Glade run, 0.9 mile S. 15° W. of Valleypoint. **Upper Freeport Coal.**

			Ft.	In.
Concealed				
Coal, bony	0'	2 "		
Coal, good	3	0		
Slate	0	1½		
Coal, good	1	0	4	3½

Slate

Elevation of coal, 1880' A. T., aneroid measurement.

The composition of the sample from the above mine, as reported by Messrs. Hite and Patton, is given under **No. 24** in the table of analyses at the end of this chapter.

Joab Groves Mine.—No. 25 on Map II.

Located 1.3 miles southward from Valleypoint. **Upper Freeport Coal.**

			Ft.	In.
Slate roof				
Coal, soft	3'	2 "		
Slate	0	1½		
Coal	0	11		

			Ft.	In.
Slate	0'	6"		
Coal, visible	0	8	5	4½

Concealed

Elevation of coal, 1845' A. T., aneroid measurement.

For analysis of sample from above mine, as reported by Messrs. Hite and Patton, see **No. 25** in the table of analyses at the end of this chapter.

George Martin Mine.—No. 26 on Map II.

Located on Martin creek, 2.4 miles S. W. of Valleypoint. **Upper Freeport Coal.**

			Ft.	In.
1. Sandstone, massive, Mahoning.....			40	0
2. Coal, bony	0'	4 "		
3. Coal, good	1	0		
4. Bone	0	1		
5. Coal	1	10		
6. Slate, coaly	0	4		
7. Coal, good	3	0		
8. Slate	0	1½		
9. Coal	0	10		
10. Bone coal	0	0½		
11. Coal	0	5	8	0

12. Slate

Elevation of coal, 1900' A. T., aneroid measurement.

The heading starts in N. 40° W. and rises rapidly on the eastern slope of the Preston anticline. The composition of the sample from only Nos. 7, 9, and 11 of section, as reported by Messrs. Hite and Patton, is given under **No. 26** in the table of analyses at the end of this chapter.

The foregoing data on the Upper Freeport coal in Pleasant district in conjunction with Map II shows the existence of a large area of this bed in fine development, running comparatively low in ash and sulphur. As in the Bretz region, the "main bench" and "mining ply" should be specially adapted for the manufacture of by-product coke.

Valley District.

Valley district lies immediately southwest of Pleasant in the western portion of the county; hence, the Upper Freeport coal therein is of the same high grade and thickness as in the

latter. The area is traversed in a northwest-southeast direction by the Morgantown and Kingwood Railroad. This means of transportation accounts for the several commercial mines in this coal along its route. In the Ligonier Basin portion, the Elkins Coal & Coke Co. and the Merchants Coal Co. have drilled 24 bore holes to test the thickness and character of this bed where it lies deeply buried below drainage. The Survey was able to obtain the logs of all these borings—Nos. 36 to 54, inclusive, on Map II—from the former company, but none from the latter. For the records of these wells the reader is referred to the table of borings and to the Index for reference to detailed logs, all of which show the Upper Freeport present in normal development.

Several sections both at country banks and commercial mines in this bed will now be given throughout the district.

In the northern edge of Valley district, the following section was measured by Hennen at the **Ezekiel Greathouse mine**, on the north side of the public road leading up Middle run, 1 mile west of Bull Run P. O.:

		Ft.	In.
Sandstone, massive, Mahoning			
Shale, sandy and dark, Uffington.....		2	0
Coal, bony	0' 10 "		
Coal, soft	2 10		
Shale, gray	0 2		
Coal, soft	1 3		
Shale, gray	0 0½		
Coal	0 3½		
Shale, gray	0 11		
Coal	1 3	7	7
Fire clay			

Elevation of coal, 1730' A. T., aneroid measurement.

All the different divisions of the bed, as designated in Chapter VII, are represented in the above section.

In the same region the following section was obtained by Hennen at the **Jenkins and Lyon bank**, located just on the east side of the axis of the Ligonier Basin, 0.3 mile eastward from Bull Run P. O.:

		Ft.	In.
Shale, sandy Uffington.....		5	0
Coal, soft	1' 6 "		
Coal, bony	0 11		
Coal, soft	2 10		
Shale, gray	0 2		

			Ft.	In.
Coal, soft.....	1'	0"		
Shale, gray.....	0	0¼		
Coal.....	0	3		
Shale, gray, "Big Slate"....	0	9		
Coal, harder.....	1	3	Upper	
Slate, dark gray.....	0	1	Freeport	
Coal, hard.....	0	9	.....	9 6¼
Fire clay				
Elevation of coal, 1535' A. T., aneroid measurement.				

Five miles southwestward in Valley district, the following section was measured by Reger at the **John Sharps mine**, located on the north side of the Kingwood pike, 1¼ miles westward from Burk:

			Ft.	In.
Sandstone, massive, Mahoning and concealed..			40	0
Shale, gray, Uffington			5	0
Coal, slaty	1'	8" Upper		
Coal, good	2	9 Freeport		
Shale, gray	0	2 Coal		
Coal, good	1	6	6	1
Fire clay, gray.....			0	6
Concealed				
Elevation of coal, 1840' A. T., aneroid measurement.				

On the eastern slope of the Ligonier Basin, the following section was obtained by Hennen at the **William Neff mine**, located on the south hillside of Dillan creek, 1 mile northwest of Kanes Creek station:

			Ft.	In.
Sandstone, massive, coarse and brown, Mahoning			20	0
Coal, bony	0'	9 "		
Coal, soft	2	6		
Shale, dark gray.....	0	2		
Coal, soft	1	0		
Slate, gray	0	0½ Upper		
Coal	0	3½ Freeport		
Shale, gray	0	11 Coal		
Coal	1	1	6	9
Concealed by water				
Elevation of coal, 1910' A. T., aneroid measurement.				

Three-fourths mile northeast of the latter opening, the following section was measured by Hennen at the **Joseph Graham mine**, a country bank in the same coal, located 1.5 miles north of Kanes Creek station:

	Ft.	In.
Sandstone, coarse	15	0
Shale, gray	0	6
Coal, bony 6" to 0' 10"		
Coal, soft 2 8		
Shale, gray 0 2		
Coal 0 5		
Concealed to floor in mine....3 0	7	1

Elevation of coal, 1990' A. T., aneroid measurement.

The difference in elevation between the last two openings illustrates in a marked manner the rapid rise of the strata to the southeast on the western slope of the Preston anticline, as also at the **William Miller mine**, located 0.5 mile northwest of Manown station, the following section at which was measured by Hennen:

	Ft.	In.
Sandstone, massive, Mahoning.....	20	0
Coal, hard, blocky.....2' 2" Upper		
Coal, soft 2 8 Freeport		
Slate, gray 0 2 Coal		
Coal, soft 1 2	6	2

Slate pavement

Elevation of coal, 2241' A. T., spirit-level measurement.

In the northeastern edge of Valley district, the following section was measured by Hennen at the **Earl Fields mine**, a country bank, located 1.6 miles north of Herring:

	Ft.	In.
Sandstone, broken, Mahoning.....	8	0
Shale, gray 6" to	0	10
Coal, bony 1' 10"		
Coal, soft 3 2		
Shale, gray 0 2 Upper		
Coal, soft 1 2 Freeport		
Shale, gray 8" to 0 10 Coal		
Coal, bony 1 9	8	11

Fire clay

Elevation of coal, 1870' A. T., aneroid measurement.

The same coal was once opened one-half mile eastward, a short distance south of the Dolph J. Conley residence, at an elevation of 1950' A. T., aneroid measurement, but the mine had fallen shut so that a section could not be obtained.

In the southern edge of Valley district, the following section was measured by Reger at an exposure of the Upper

Freeport coal on the north hillside of Squires creek, 1.9 miles southeast of Browns Mills, where the bed has its usual normal development:

	Ft.	In.
Sandstone, massive, Mahoning.....	15	0
Slate, black	0	3
Coal, bony.....0' 10"		
Coal, soft	2	3
Shale, gray	0	5
Coal	1	5
Shale, gray	0	10
Coal	2	0
Shale, gray, concealed, and sandy shale to bed of Squires creek	30	0
Elevation of coal, 1545' A. T., aneroid measurement.		

Reger reports about the same thickness of this coal, 0.9 mile southwestward, at an exposure of the bed on the north bank of the same stream.

A discussion of the samples and sections of this coal at the several commercial mines in Valley district will now be given. The chemical results therein are as reported by Messrs. Hite and Krak of the Survey staff.

Preston County Coke Co. Mine No. 1—No. 27 on Map II.

Valley district, 1.2 miles N. 45° W. of Masontown. **Upper Freeport Coal.**

	Ft.	In.
1. Draw slate.....		
2. Coal, bony	1' 10"	
3. Coal, soft	2	8
4. Slate, black	0	1½
5. Coal, soft	1	1
6. Slate, black.....	0	1
7. Coal	0	4
8. Shale, gray	6	1½

Tidal elevation, 1820' aneroid; principal office, Cascade; daily capacity for Mines Nos. 1, 2 and 3, 400 tons; 15 laborers and 70 miners employed; electric haulage; coal shipped east; coke shipped west for steel; 194 beehive ovens; butts, N. 64° W.; faces, N. 26° E.; greatest rise, N. 64° W.; sample collected for analysis from Nos. 3, 5 and 7 of section, in 3rd Right Heading, by D. B. Reger; H. C. Greer, President, authority for data.

For analysis and calorific value of sample from the above mine, see **No. 27** in table of coal analyses at end of this chapter.

Preston County Coke Co. Mine No. 2—No. 28 on Map II.

Valley district, 1.0 mile N. 45° W. of Masontown. **Upper Freeport Coal.**

			Ft.	In.
1.	Draw slate			
2.	Coal, bony	2' 0"		
3.	Coal, soft	2 4		
4.	Slate, black	0 2		
5.	Coal, good	1 5	5	11
6.	Shale, gray			

Tidal elevation, 1820', aneroid; sample for analysis collected from Nos. 3 and 5 of section in First Butt Heading, by D. B. Reger. See Mine No. 1 (Map No. 27) for data.

For analysis and calorific value of sample from above mine, see **No. 28** in table of analyses at end of this chapter.

Preston County Coke Co. Mine No. 3—No. 29 on Map II.

Valley district, 1.0 mile N. 20° W. of Masontown. **Upper Freeport Coal.**

			Ft.	In.
1.	Draw slate			
2.	Coal, bony	16" to 1' 8"		
3.	Coal, soft	2 8		
4.	Slate, black	0 2		
5.	Coal, soft	1 4	5	10
6.	Shale, gray			

Tidal elevation, 1830', aneroid; sample collected for analysis from Nos. 3 and 5 of section in Room No. 5 off 2nd Left, by D. B. Reger. (See Mine No. 1, No. 27 on Map II, for other data).

For analysis and calorific value of sample from above mine, see **No. 29** in table of analyses at end of this chapter.

Elkins Coal & Coke Co. No. 6 (Masontown No. 5)—No. 30 on Map II.

Valley district, 0.2 mile N. 80° W. of Masontown. **Upper Freeport Coal.**

			Ft.	In.
1.	Draw slate			
2.	Coal, slaty.	1' 7 "		
3.	Coal, bony	0 9		
4.	Coal, soft	2 11		
5.	Slate, gray	0 2		
6.	Coal	1 2½	6	7½
7.	Shale, gray			

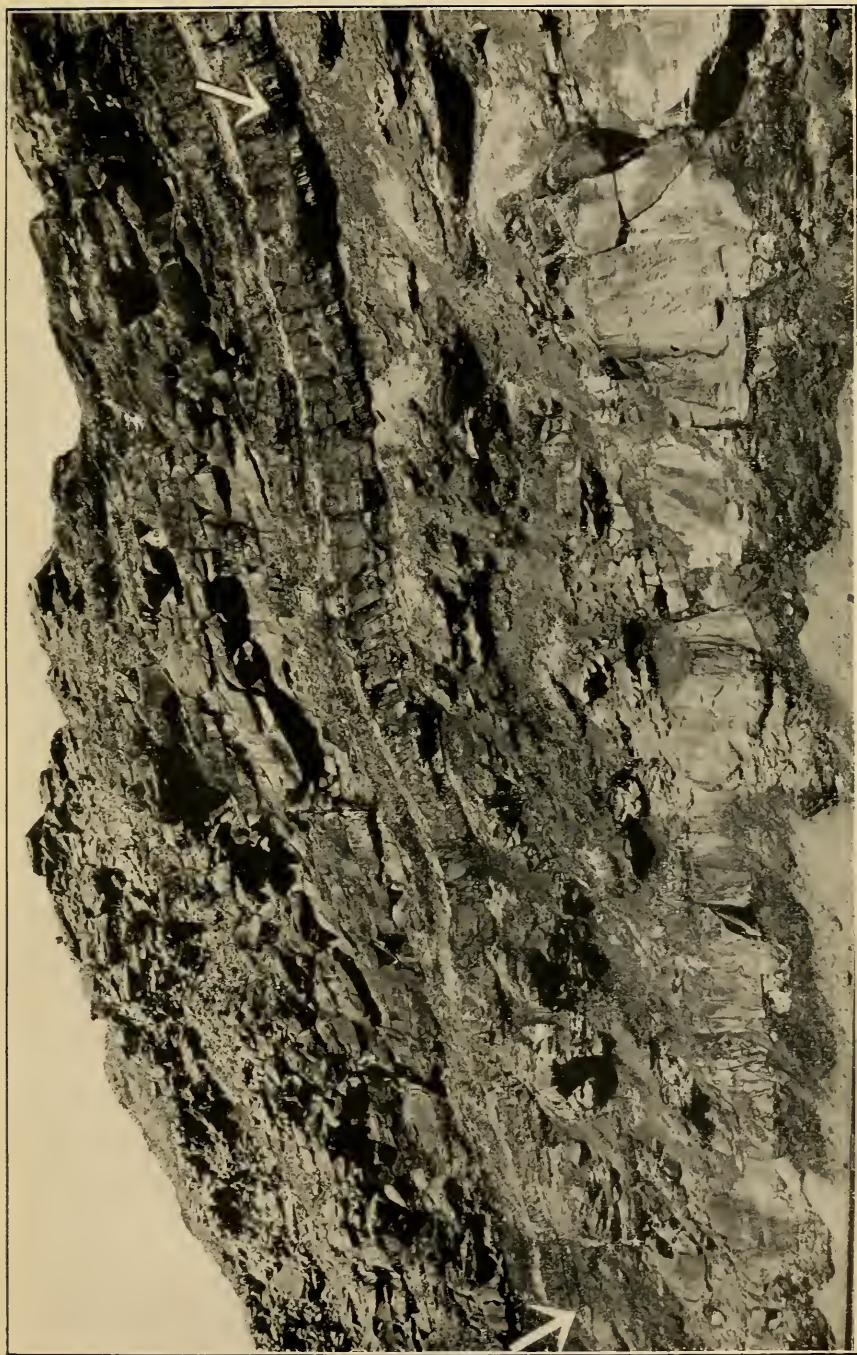


PLATE XXVI.—View in B. & O. Ry. cut No. 80 at Blaser, showing Mahoning Sandstone at top; Upper Freeport Coal at
white arrows in middle; and Upper Freeport Sandstone at bottom.

Photo by E. E. Knight

Tidal elevation, 1569' L-A. T. Sample collected for analysis from Nos. 4 and 6 of section in Main Heading by D. B. Reger. (See Masontown No. 4—No. 31 on Map II—for other data).

For analysis and calorific value of sample from above mine, see **No. 30** in the table of analyses at end of this chapter.

Elkins Coal & Coke Co. No. 6 (Masontown No. 4)—No. 31 on Map II.

Valley district, 1.1 miles N. 70° E. of Masontown. **Upper Freeport Coal.**

			Ft.	In.
1.	Draw slate			
2.	Coal	1' 10"		
3.	Bone coal	0 9		
4.	Coal, soft	2 9		
5.	Slate, gray	0 2		
6.	Coal	1 1½		
7.	Shale, gray	0 8		
8.	Coal	1 6	8	9½
9.	Concealed			

Tidal elevation, 1567' L-A. T. Principal office, Morgantown; daily capacity of Nos. 4 and 5 openings, 700 tons; 39 laborers and 95 miners employed; electric haulage; coal shipped east for by-product use; 80 coke ovens not in use; Bradford dry breaker; butts, N. 66° W.; faces, N. 24° E.; greatest rise, northwest; sample collected for analysis from Nos. 4 and 6 of section in Flat Heading by D. B. Reger; B. J. McDermott, chief engineer, authority for data.

For analysis and calorific value of sample from above mine, see **No. 31** in table of analyses at the end of this chapter.

Elkins Coal & Coke Co. No. 2 (Bretz)—No. 32 on Map II.

Valley district, at Bretz. **Upper Freeport Coal.**

			Ft.	In.
1.	Draw slate			
2.	Coal, good	1' 10"		
3.	Coal, bony	1 0		
4.	Coal, soft	3 0		
5.	Slate, black	0 2		
6.	Coal, good	1 0		
7.	Shale, gray	0 8		
8.	Coal	1 6	9	2
9.	Shale			

Tidal elevation, 1742' L-A. T.; principal office, Morgantown; daily capacity, 500 tons; 55 laborers and 70 miners employed; electric haulage; coal shipped east for by-product use, and some coked on ground; 267 coke ovens, about 50 in use; butts, N. 66° W.; faces, N. 24° E.; greatest rise, northwest; Bradford dry breaker; sample collected for

analysis from Nos. 4 and 6 of section in east crosscut on Main Dip Entry by D. B. Reger; B. J. McDermott, chief engineer, authority for data.

For analysis and calorific value of sample from above mine, see **No. 32** in table of analyses at end of this chapter. This mine was once sampled by Hennen and the analysis published under No. 23 on page 530 of Volume II(a) of the State Survey Reports.

Elkins Coal & Coke Co. No.-7 (Burk No. 4)—No. 33 on Map II.

Valley district, 2.0 miles N. 60° W. of Reedsville; **Upper Freeport Coal.**

			Ft.	In.
1. Draw slate				
2. Bone coal	1'	1 "		
3. Coal, soft	2	9½		
4. Slate, black	0	1½		
5. Coal	1	6	5	6
6. Shale, gray				

Tidal elevation, 1787' L.A. T.; sample collected for analysis from Nos. 3 and 5 of section in Main Heading by D. B. Reger; see Burk No. 1 (No. 36 on Map II) for data.

For analysis and calorific value of sample from above mine, see **No. 33** in table of analyses at end of this chapter.

Elkins Coal & Coke Co. No. 7 (Burk No. 2)—No. 34 on Map II.

Valley district, 1.7 miles N. 55° W. of Reedsville; **Upper Freeport Coal.**

			Ft.	In.
1. Draw slate				
2. Bone coal	1'	0 "		
3. Coal, soft	2	8		
4. Shale, black	0	2		
5. Coal	1	1		
6. Slate, black	0	1½		
7. Coal, soft	0	3½		
8. Shale, gray	1	1		
9. Coal, soft	1	5	7	9
10. Shale				

Tidal elevation, 1763' L.A. T.; sample collected for analysis from Nos. 3, 5 and 7 of section in 1st Butt by D. B. Reger; see Burk No. 1 (No. 36 on Map II) for data.

For analysis and fuel value of sample from above mine, see **No. 34** in table of analyses at end of this chapter.

Elkins Coal & Coke Co. No. 7 (Burk No. 3)—No. 35 on Map II.

Valley district, 1.6 miles N. 45° W. of Reedsville; **Upper Freeport Coal.**

			Ft.	In.
1.	Draw slate			
2.	Bone coal 1'	7 "		
3.	Coal, soft.....2	7½		
4.	Slate, gray 0	1½		
5.	Coal 1	2		
6.	Slate, gray 0	0½		
7.	Coal, soft 0	4		
8.	Shale, gray 1	0		
9.	Coal, soft 1	6	8	4½

Tidal elevation, 1751' L-A. T.; sample collected for analysis from Nos. 3, 5 and 7 of section in Main Heading by D. B. Reger; see Burk No. 1 (No. 36 on Map II) for data.

For analysis and fuel value of sample from above mine, see **No. 35** in table of analyses at end of this chapter.

Elkins Coal & Coke Co. No. 7 (Burk No. 1)—No. 36 on Map II.

Valley district, 1.5 miles N. 50° W. of Reedsville; **Upper Freeport Coal.**

			Ft.	In.
1.	Draw slate			
2.	Slate, black 0'	6 "		
3.	Coal, bony 1	3		
4.	Coal, soft 2	9½		
5.	Slate, black 0	2		
6.	Coal 1	1		
7.	Slate ¼" to 0	0½		
8.	Coal 0	4½	6	2½
9.	Shale			

Tidal elevation, 1713' L-A. T.; principal office, Morgantown; capacity for Burk Nos. 1, 2, 3 and 4, 300 tons; output 125 tons; 14 laborers and 22 miners employed; electric haulage; coal shipped east to South Bethlehem, Pa., for by-product use; butts, N. 66° W.; faces N. 24° E.; greatest rise, northwest; sample collected for analysis from Nos. 4, 6 and 8 of section in Room No. 1, off Heading No. 1, by D. B. Reger; B. J. McDermott, chief engineer, authority for data.

For analysis and fuel value of sample from above mine, see **No. 36** in table of analyses at end of this chapter.

The foregoing analyses and calorimeter tests on the Upper

Freeport in Valley district reveal the high grade character of the coal in this region. In fact about fifty per cent. of the output of the Elkins Coal & Coke Company is shipped east for use in by-product ovens, giving highly satisfactory results.

Lyon District.

Lyon district lies immediately south of Valley and along the western border of Preston county. Over the greater portion of its area the Upper Freeport coal is below drainage. Its area is traversed in an east and west direction by the main line of the Baltimore & Ohio Railroad, and in the eastern edge of the district, along the latter road, there are five commercial mines driven on the crop of this bed. Thirteen coal test borings—Nos. 61 to 73 inclusive, on Map II—have been sunk in Lyon, the detailed logs of some of which are published on preceding pages of this chapter. Nos. 63 and 65, near Independence show this vein absent from the measures. These may have encountered a local "hogback" or "clay seam," since No. 63, 1 mile eastward at Newburg, exhibits this coal in normal development.

Several sections both at country banks and commercial mines will now be given throughout the district.

In the northern edge of Lyon, the Upper Freeport coal was once opened on the land of **Geo. B. Jackson**, $\frac{1}{4}$ mile due north of Gladesville, at an elevation of 1860' A. T., aneroid measurement, but when visited during 1912 by Hennen the mine had fallen shut. Mr. Jackson reported 4 feet of coal with a 2-inch slate parting just below the middle.

The following section was measured at an exposure of the horizon of this coal along the bed of Stony run, $\frac{3}{4}$ mile southwest of Browns Mills:

	Ft.	In.
Fire clay, with cherty conglomerate.....	5	0
Coal 0' 6" }		
Slate, gray 0 2 }	1	1
Coal 0 5 }		
Fire clay, Bolivar, good.....	4	0
Shale, sandy, with iron ore and limestone boulders, Upper Freeport.....	15	0
Elevation of coal, 1500' A. T., aneroid measurement.		

At the above point the coal comes about 100 feet below

the marine fossiliferous Brush Creek limestone and appears to represent without doubt the Upper Freeport bed. Its poor development at this place is probably due to its location in a possible extension of the barren streak exhibited in Bore Holes Nos. 63 and 65 near Independence. The logs of the bore holes near Browns Mills, which the Survey was unable to obtain, should throw some light on the subject. Slightly over a mile eastward the coal is in normal development at the openings on Squires creek, as described on preceding pages of this chapter for the Upper Freeport in Valley district.

Three miles southwestward a sample for analysis was collected and the following section measured by Reger at a mine in this coal, located on Martins run, 1.2 miles northeast of the common corner of Monongalia, Marion and Preston counties:

S. H. Volyard Mine—No. 43 on Map II.

		Ft.	In.
1. Sandstone		5	0
2. Concealed		7	0
3. Shale, black.....		4	0
4. Coal	1' 3"	} Upper Freeport.....	2 1
5. Slate, dark, gray and hard.....	0 1		
6. Coal	0 9		
7. Slate			

Elevation of coal, 1540' A. T., aneroid measurement.

The composition of the sample from Nos. 4 and 6 of the above section is given under **No. 43** in the table of analyses at the end of this chapter.

It is possible that the above bed may represent the Lower Freeport seam, since it comes about 325 feet below the definitely correlated Harlem coal exposed at the edge of the road, 0.3 mile southward.

Passing to the eastern edge of Valley district, the following section was measured by Reger at a mine in the Upper Freeport, located along Lick run, 1.6 miles northwest of Oriole:

		Ft.	In.
Shale, dark, visible		6	0
Coal, bony	1' 3"	} 4	6
Coal, good	3 3		
Shale, gray, visible.....		1	0

Elevation of coal, 1360' A. T., aneroid measurement.

In the same region Reger measured the following section at the **R. A. Pyles mine**, a country bank, located at the east edge of the public road, 0.4 mile west of Oriole:

	Ft.	In.
Sandstone		
Slate, black.....	0	4
Coal, bony 1' 1"		
Coal, good 2 9		
Shale, gray 0 3		
Coal, good 1 5	5	6

Shale

Elevation of coal, 1545' A. T., aneroid measurement.

The last two mines show the Upper Freeport in normal thickness.

The following section was measured by Hennen at the **J. C. Bucklew mine**, a country bank located near the axis of the Ligonier Basin on the west side of Threefork creek, 0.5 mile above the mouth of Martins run:

	Ft.	In.
Slate, black	1	0
Coal bony 0' 7"		
Coal, soft.....2 6		
Slate, gray 0 2		
Coal 1 0	4	3

Slate and concealed.....

Elevation of coal, 1265' A. T., aneroid measurement.

Passing to the southeast edge of Valley district, the following section was measured at the crop of this coal in a cut along the Baltimore & Ohio Railroad, $\frac{1}{4}$ mile east of Austen:

	Ft	In.
Concealed		
Fire clay, flinty.....5' 0"	13	0
Fire clay, plastic.....8 0		
Sandstone, massive, coarse, greenish gray, Lower Mahoning	50	0
Shale, dark, sandy, Uffington.....	10	0
Coal, bony.....1' 0"		
Coal, soft 3 0		
Shale, gray 0 2		
Coal, soft 1 5		
Shale, gray 1 0	8	0
Coal, slaty 1 5		
Fire clay		

Elevation of coal, 1605' A. T., aneroid measurement.

An account of the sections made and the samples collected

at the commercial mines in the district will now be given. The analyses and fuel tests are as reported by Messrs. Hite and Krak:

Virginia-Maryland Coal Corporation, Scotch Hill Mine—No. 44 on Map II.

Lyon district, at Newburg; Upper Freeport Coal.

		Ft.	In.
1. Sandstone, massive, Mahoning.....			
2. Slate.....	12" to usually 0' 0"		
3. Coal, sulphur streak.....	0 4		
4. Coal, soft.....	2 4		
5. Slate, dark	0 2		
6. Coal, good, harder.....	1 5		
7. Shale	1 0		
8. Coal	0 8	5	11
9. Shale			

Sample collected for analysis from Nos. 4 and 6 of section in heading 700' south of shaft by D. B. Reger; mine not in operation.

For composition and fuel value of the above coal, see No. 44 in table of analyses at end of this chapter. The Lower Kittanning coal is at present being mined from this shaft, a discussion of the character of which is given on a subsequent page.

The above mine was once sampled by A. P. Brady for the Survey, and the section and proximate analysis published on page 412 of Volume II of the State Geological Reports.

Hiorra Coke Co., Vulcan Mine—No. 45 on Map II.

Lyon district, 0.2 mile west of Hiorra; Upper Freeport Coal.

		Ft.	In.
1. Draw slate			
2. Coal, soft	2' 8½"		
3. Slate, black.....	1" to 0 2		
4. Coal, good	1 7	4	5½
5. Shale			

Tidal elevation, 1380', aneroid; principal office, Uniontown, Pa.; daily capacity, 300 tons; 13 laborers and 50 miners employed; electric haulage; coal shipped east for steam; butts, N. 78° W.; faces, N. 12° E.; greatest rise, east; sample collected for analysis from Nos. 2 and 4 of section in Room No. 2 off 11th East, by D. B. Reger; George L. Humphreys, superintendent, authority for data.

For composition and fuel value of above coal, see No. 45 in table of analyses at end of this chapter.

The above mine was once sampled by A. P. Brady for the Survey, and the proximate analysis published on page 411 of Volume II of the State Geological Reports.

Hite Coal and Coke Co., Dixie Mine—No. 46 on Map II.

Lyon district, 1.1 miles N. 70° W. of Austen; **Upper Freeport Coal.**

			Ft.	In.
1.	Draw slate			
2.	Coal, bony	0' 2 "		
3.	Coal, soft	2 8		
4.	Slate, black	0 1½		
5.	Coal, good, hard at bottom	1 7	4	6½
6.	Shale, gray			

Tidal elevation, 1394', spirit level; principal office, Fairmont, W. Va.; daily capacity, 200 tons; output, 60 tons; 8 laborers and 15 miners employed; horse haulage; shipped east for steam; butts, N. 78° W.; faces, N. 12° E.; greatest rise, northeast; sample collected for analysis from Nos. 3 and 5 of section in Room No. 8 in 6th Right, by D. B. Reger; Lloyd Bailey, general superintendent, authority for data.

For composition and fuel value of above coal, see No. 46 in table of analyses at end of this chapter.

The above mine was once sampled by A. P. Brady for the Survey, and the proximate analysis published on page 411 of Volume II of the West Virginia Geological Survey Reports.

Austen Coal & Coke Co., Mine No. 2—No. 47 on Map II.

Lyon district, 0.7 mile No. 75° W. of Austen; **Upper Freeport Coal.**

			Ft.	In.
1.	Draw slate			
2.	Bone coal	0' 3 "		
3.	Coal, soft	2 8		
4.	Shale, gray.....	0" to 0 1½		
5.	Coal, soft	1 5	4	5½
6.	Shale			

Tidal elevation, 1480', aneroid; principal office, Austen, W. Va.; sales offices, 90 West St., New York, and Land Title Bldg., Philadelphia, Pa.; daily capacity, 200 tons; 7 laborers and 33 miners employed; electric haulage; coal shipped east to Atlas Portland Cement Co., and to Spreckels Sugar Co.; butts, N. 78° W.; faces, N. 12° E.; greatest rise, east; sample collected for analysis from Nos. 3 and 5 of section in Room No. 5 on 8th East, by D. B. Reger; F. W. Horchler, superintendent, authority for data.



PLATE XXVII.—Showing Bretz No. 2 Mine, tippie and bee-hive coke ovens at Mine No. 32 on Map II. Conemaugh topography in middle ground; and Pottsville, capping ridge in extreme background.

Photo by courtesy of C. Mc. Lemley

For composition and fuel value of above coal, see **No. 47** in table of analyses at end of this chapter.

Austen Coal & Coke Co., Mine No. 1—No. 48 on Map II.

Lyon district, 0.5 mile N. 80° W. of Austen; **Upper Freeport Coal.**

			Ft.	In.
1. Draw slate				
2. Coal, bony	0'	3"		
3. Coal, soft	2	9		
4. Slate, black.....	0	2		
5. Coal, soft.....	1	7	4	9
6. Shale, gray				

Tidal elevation, 1475', aneroid; principal office, Austen, W. Va.; sales offices at 90 West St., New York, and Land Title Bldg., Philadelphia, Pa.; daily capacity, 500 tons; 15 laborers and 74 miners employed; electric haulage; entire product used for coke; 228 bee-hive ovens; 66 per cent of coke recovered; coke used for steel work; butts, N. 78° W.; faces, N. 12° E.; greatest rise, east; sample collected for analysis from Nos. 3 and 5 of section, in Main Face Entry crosscut, by D. B. Reger; F. W. Horchler, superintendent, authority for data.

For composition and fuel value of above coal, see **No. 48** in table of analyses at end of this chapter.

The above coal as well as coke manufactured therefrom was once sampled by A. P. Brady for the Survey, and the analyses, as published on page 411 of Volume II of the State Geological Reports, are as follows:

	Coal.	Coke.
Moisture	0.72	0.18
Volatile Matter	28.67	1.30
Fixed Carbon	63.78	86.33
Ash	6.83	12.19
Totals	100.00	100.00
Sulphur	0.94	0.86
Phosphorus	0.048	0.067
B. T. U. (Williams calorimeter).....	14,403	

Gorman Coal & Coke Co., Mine No. 4—No. 49 on Map II.

Lyon district, 0.5 mile N. 15° E. of Austen; **Upper Freeport Coal.**

			Ft.	In.
1. Draw slate				
2. Coal, bony	1'	0"		
3. Coal, soft.....	2	8		
4. Slate, gray.....	0'	1½" to 0	4	
5. Coal, good	1	4	5	4
6. Shale, gray				

Tidal elevation, 1610', aneroid; principal office, No. 900 Continental Bldg., Baltimore, Md.; daily capacity, 25 tons; 1 laborer and 5 miners employed; horse haulage; shipped east; butts, N. 70° W.; faces, N. 20° E.; greatest rise, east; sample collected from Nos. 3 and 5 of section, in 2nd Right, by D. B. Reger; Thomas Murphy, superintendent, authority for data.

For composition and fuel value of above coal, see No. 49 in table of analyses at end of this chapter.

The foregoing tests on samples of the Upper Freeport in Lyon do not show the coal quite as low in sulphur and ash, or quite so high in heat units as those for the same bed in the Bretz region of Valley district, given on preceding pages of this chapter. The results, however, reveal a high grade coal which, with proper care in mining, should be well adapted to by-product coke manufacture.

Kingwood District.

Kingwood district lies immediately east of Valley and Lyon and has a greater acreage of the Upper Freeport coal than either of the two latter areas. The district is traversed by three different railroads, which has resulted in a number of commercial mines being opened on this bed. The Elkins Coal & Coke Co. has sunk 15 bore holes (see table of borings, page 221) within its borders, the detailed logs of several of which are given on preceding pages of this chapter. These tests are grouped largely in the region north and northwest of Kingwood, and show the coal generally present in good development.

Before taking up the discussion of the commercial mines, several sections at country banks scattered throughout the district will first be given:

In the northern edge of Kingwood district, the following data were obtained at the **Caddell Lumber Co. mine** in the Upper Freeport on the west bank of Cheat river, 300 to 500 feet below the mouth of Green run:

			Ft.	In.
Shale, sandy, dark.....			5	0
Coal	1' 5½"			
Slate, black	0 1	Upper		
Coal	0 8½	Freeport		
Slate, gray	0 2	Coal		
Coal	1 10		4	3

Slate pavement

Elevation of coal, 1230' A. T., aneroid measurement.

Three miles westward the following section was measured by Hennen at the **Thos. Garner mine** on the north hillside of Green run, 2.5 miles N. 10° W. of Kingwood:

			Ft.	In.
Sandstone, massive				
Coal, bony.....	0'	7 "		
Slate, black	0	1	Upper	
Coal, bony	0	5	Freeport	
Coal, soft	2	7	Coal	
Slate, dark, gray.....	0	1½		
Coal	1	1	4	10½

Shale, gray.....
Elevation of coal, 2055' A. T., aneroid measurement.

The following was obtained by Hennen at the **Allen Fawcett mine**, on the waters of Morgan run, 0.7 mile southeast of Oak Grove Church:

			Ft.	In.
Slate				
Coal, bony.....	1'	9 "	Upper	
Coal, soft	3	2	Freeport	
Slate, gray	0	1½	Coal	
Coal, soft	1	6	6	6½

Slate

Elevation of coal, 2170' A. T., aneroid measurement.

It is the Upper Freeport coal that crops in the Kingwood pike southward from Manown and about one-eighth mile west of Oak Grove Church, where the following data were obtained:

			Ft.	In.
Concealed				
Coal, soft	1'	3"		
Slate, gray, "little slate"....	0	2		
Coal, soft	1	5	Upper	
Slate, gray "big slate".....	0	9	Freeport	
Coal, soft.....	1	5	Coal	
Slate, gray	0	2		
Coal	0	4	5	6

Fire clay

Elevation of coal, 2300' A. T., aneroid measurement.

In the northwest edge of Kingwood district, the following section was measured by Hennen at a mine in the Upper Freeport coal, located on the point just east of the road fork on Squires creek, slightly over a mile northeast of Hopewell Church:

			Ft.	In.
Sandstone, massive, Lower Mahoning.....			20	0
Coal, bony.....	0'	10"		
Coal, soft.....	2	7		
Slate, gray	0	2		
Coal	1	8	5	3

Slate

Elevation of coal, 1630' A. T., aneroid measurement.

Passing eastward, the following section was obtained by Hennen at a country bank on the north hillside of Morgan run, 0.9 mile northwest of Snyder station:

			Ft.	In.
Sandstone				
Shale, dark gray.....			3	0
Coal, bony	1'	9"		
Coal, soft	2	7		
Slate, gray	0	2		
Coal, soft.....	1	1	5	7

Slate

Elevation of coal, 1880' A. T., aneroid measurement.

In the southwest edge of Kingwood district, the following section was measured by Reger at a country bank in the same coal, located on the south side of the road, 1.5 miles S. 70° W. from Howesville:

			Ft.	In.
Sandstone, massive				
Shale, gray			1	0
Coal, bony	1'	0"		
Coal, soft	2	6		
Shale, gray	0	2		
Coal	1	6	5	2

Shale

Elevation of coal, 1890' A. T., aneroid measurement.

Southeastward the same coal is opened at the Thos. Miller mine, on the north side of Lick run, 0.7 mile N. 25° E. of Camp Chapel, where the following section was measured by Reger:

			Ft.	In.
Sandstone, flaggy, Mahoning.....			10	0
Shale, gray			0	3
Coal, bony	0'	11"		
Coal, good	2	10		
Slate, dark	0	3		
Coal	1	8		
Shale, gray	1	0		
Coal	1	5	8	1

Shale

Elevation of coal, 1800' A. T., aneroid measurement. *

One-fourth mile southward it is this bed that is opened at the **Benjamin Miller bank** at the road side on the south side of Lick run, where about the same section is exposed except that the bottom coal is concealed.

A description of the sections made and samples collected at the commercial mines in the Upper Freeport coal in Kingwood district will now be given:

As published on page 530 of Volume II(a) of the State Geological Survey Reports, the composition and fuel value of the Upper Freeport coal at **Mine No. 4** of the **Elkins Coal & Coke Company** are given under **No. 37** in the table of analyses at the end of this chapter.

Irona Coal Co., Irona Mine No. 2—No. 39 on Map II.

Kingwood district, 0.2 mile N. 10° E. of Irona; **Upper Freeport Coal.**

		Ft.	In.
1. Draw slate			
2. Coal, bony	0' 3 "		
3. Coal, soft	2 11		
4. Slate, dark	0 2		
5. Coal, good	1 7½	4	11½
6. Shale, gray			

Tidal elevation, 1790', aneroid; principal office, Philadelphia, Pa.; daily capacity, 500 tons; 12 laborers and 48 miners employed; rope haulage; butts, N. 75° W.; faces, N. 15° E.; pocket compass determination; greatest rise, northwest; sample collected for analysis from Nos. 3 and 5 of section in room No. 1 off 4th Left, by D. B. Reger; D. J. Grubbe, rope rider, authority for data.

For composition and fuel value of above coal, see **No. 39** in table of analyses at the end of this chapter.

The above mine was once sampled by A. P. Brady for the Survey, and the section and analysis published on page 409 of Volume II of the State Geological Reports.

Borgman Coal Company—No. 40 on Map II.

Kingwood district, 1.0 mile S. 80° W. of Irona; **Upper Freeport Coal.**

		Ft.	In.
1. Draw slate			
2. Bone coal.....	10" to 1' 0 "		
3. Coal, soft.....	2 5		
4. Slate, dark	0 1½		
5. Coal, soft	1 9	5	3½
6. Shale, gray			

Tidal elevation, 2060', aneroid; principal office, Tunnelton, W. Va., R. F. D. No. 2; daily capacity, 300 tons; 18 laborers and 43 miners employed; horse haulage and rope incline up to railroad; coal shipped east for steam; butts, N. 74° W.; faces, N. 16° E., pocket compass determination; greatest rise, N. 62° W.; sample collected for analysis from Nos. 3 and 5 of section in chain pillar on 4th Left, by D. B. Reger; F. W. Borgman, general manager, authority for data.

For composition and fuel value of coal from above mine, see No. 40 in table of analyses at the end of this chapter.

Kingwood Coal Co., Mine No. 1—No. 41 on Map II.

Kingwood district, 0.4 mile, S. 10° W. of Howesville; **Upper Freeport Coal.**

		Ft.	In.
1. Sandstone, massive, Mahoning.....			
2. Coal, slaty.....	1' 0 "		
3. Coal, soft	2 6		
4. Slate, gray	0 2½		
5. Coal, soft	1 6½	5	3
6. Shale, gray.....			

Tidal elevation, 2160', aneroid; principal office, 1102 North American Bldg., Philadelphia, Pa.; capacity, 250 tons; 9 laborers and 30 miners employed; coal shipped east for steam and cement burning; butts, N. 80° W.; faces, N. 10° E.; greatest rise, northeast; sample collected for analysis from Nos. 3 and 5 of section in First Left Dip by D. B. Reger; Isaac Conn, superintendent, authority for data.

For composition and fuel value of above coal, see No. 41 in table of analyses at the end of this chapter.

The above mine was once sampled by A. P. Brady for the Survey, and the section and analysis published on pages 408-409 of Volume II of the State Geological Reports.

Kingwood Coal Co., Mine No. 2—No. 42 on Map II.

Kingwood district, 0.4 mile south of Howesville; **Upper Freeport Coal.**

		Ft.	In.
1. Sandstone, massive, Mahoning.....			
2. Coal, sulphurous	0' 10 "		
3. Coal, good	1 8		
4. Slate, gray	0 2½		
5. Coal, soft	1 8		
6. Shale, gray	1 2	5	6½
7. Coal, thickness concealed			

Tidal elevation, 2165', aneroid; principal office, 1102 North American Bldg., Philadelphia, Pa.; daily capacity, 125 tons; 4 laborers and

15 miners employed; coal shipped east; butts, N. 74° W.; faces, N. 16° E.; greatest rise, northeast; sample collected for analysis from Nos. 3 and 5 of section, in Main Heading, by D. B. Reger; Isaac Conn, superintendent, authority for data.

For composition and fuel value of above coal, see No. 42 in table of analyses at the end of this chapter.

Gorman Coal & Coke Co., Mine No. 2—No. 50 on Map II.

Kingwood district, 0.6 mile N. 60° E. of Austen; Upper Freeport Coal.

		Ft.	In.
1. Draw slate			
2. Bone coal	0'	8"	
3. Coal, soft	2	9	
4. Slate, gray	0	2	
5. Coal, good	1	8	5 3
6. Shale			

Tidal elevation, 1670', aneroid; principal office, No. 900 Continental Bldg., Baltimore, Md.; daily capacity, 300 tons; 10 laborers and 50 miners employed; horse haulage; coal shipped east; butts, N. 70° W.; faces, N. 20° E.; greatest rise, east; sample collected for analysis from Nos. 3 and 5 of section, in Face Heading of 4th East, by D. B. Reger; Thomas Murphy, superintendent, authority for data.

For composition and fuel value of above coal, see No. 50 in table of analyses at the end of this chapter.

The above mine was once sampled by A. P. Brady for the Survey, and the section and analysis published on pages 410-411 of Volume II of the State Geological Reports.

Gorman Coal & Coke Co., Mine No. 3—No. 51 on Map II.

Kingwood district, 0.5 mile N. 80° E. of Austen; Upper Freeport Coal.

		Ft.	In.
1. Sandstone, Mahoning			
2. Draw slate	1'	10"	2 6
3. Slate, black		0	2
4. Bone coal	0'	8"	
5. Coal, soft	3	2	
6. Slate, gray	0	2	
7. Coal	1	6	5 6
8. Slate, gray			

Tidal elevation, 1655', aneroid; principal office, No. 900 Continental Bldg., Baltimore, Md.; daily capacity, 100 tons; 3 laborers and 20 miners employed; horse haulage; coal shipped east; butts, N. 70° W.; faces, N. 20° E.; greatest rise, east; sample collected for analysis

from Nos. 5 and 7 of section, in First East Entry, by D. B. Reger; Thomas Murphy, superintendent, authority for data.

For composition and fuel value of above coal, see **No. 51** in table of analyses at the end of this chapter.

Atlantic Coal Company—No. 54 on Map II.

Kingwood district, 1.6 miles N. 50° E. of Tunnelton; **Upper Freeport Coal.**

		Ft.	In.
1. Draw slate, visible		5	0
2. Coal, bony	0' 8"		
3. Coal, soft	2 7		
4. Slate, gray	0 2		
5. Coal, soft	1 8		
6. Shale, gray	0 10		
7. Coal, soft	0 8		
8. Coal, bony	0 3		
9. Coal, soft	0 6		
10. Shale, gray	0 1		
11. Coal	8	8	1
12. Shale, gray			

Tidal elevation, 1740', aneroid; electric haulage; butts, N. 78° W.; faces, N. 12° E.; greatest rise, to the northwest; sample for analysis collected from Nos. 3 and 5 of section in Main Heading, by D. B. Reger; mine not in operation; no one on duty.

For composition and fuel value, see **No. 54** in table of analyses at the end of this chapter.

The foregoing results in Kingwood district show the Upper Freeport running higher in sulphur and ash and lower in heat units than the same coal in the Bretz region of Valley district.

Reno District.

The minable area of the Upper Freeport coal is confined to the western half of Reno district, as a glance at Map II will readily show. The main line of the Baltimore & Ohio Railroad is its northern boundary; hence, along the same are two commercial mines on this vein. Ten bore holes have been sunk within its area and along its southern border in the edge of Barbour county to test the underlying coals (see table, pages 220-221), but the Survey was able to obtain the detailed logs of only seven, all of which are given on preceding pages of this chapter. Only No. 89, located 0.8 mile N. E. of Evans-

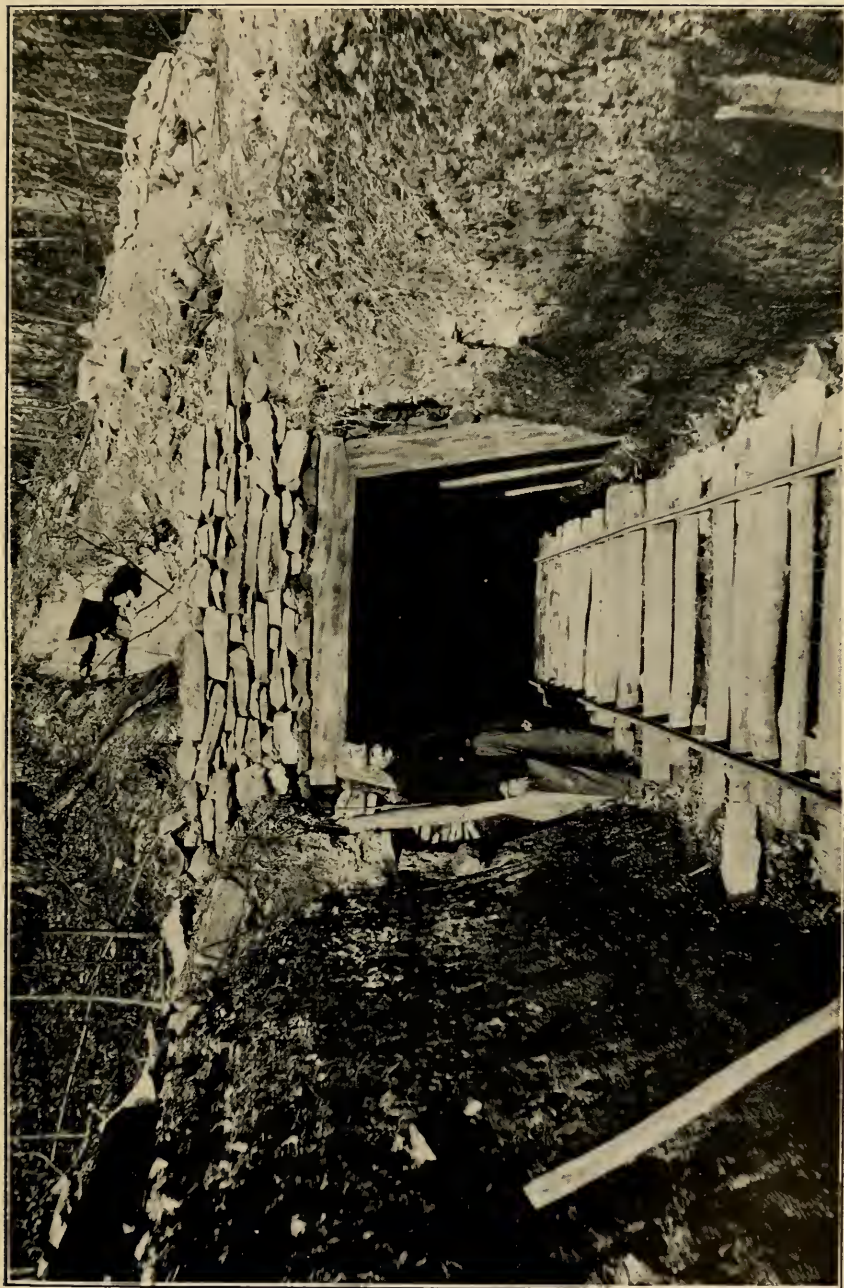


PLATE XXVIII.—Showing the Upper Freeport Coal at entrance to Mine No. 4 of the Elkins Coal & Coke Co at Kingwood.

Photo by courtesy of C. McC. Lemley

ville, fails to report this coal in minable thickness, and it may have encountered a local "roll" or "clay seam."

The following section was measured by Hennen at the **Walter Goff mine**, a country bank in the Upper Freeport, located on the west edge of the public road, 1.5 miles southwest of the east portal of the Tunnelton tunnel:

		Ft.	In.
1. Sandstone, Mahoning			
2. Slate, dark	6" to	1	5
3. Coal, bony	1' 3"		
4. Coal, soft	2	8	
5. Shale, gray	0	2	
6. Coal	1 6	5	7
7. Shale, gray		0	6
Elevation of coal, 1775' A. T., aneroid measurement.			

Only Nos. 4 and 6 of section are mined, the coal being sold at the dump at 3½ cents a bushel for local domestic fuel.

Passing eastward, the following section was measured by Hennen at a country bank in this coal on the east side of the public road, 1.6 miles southeast of Tunnelton station:

		Ft.	In.
Concealed			
Coal, bony	0' 6"		
Coal, soft	2 8		
Slate, dark	0 2		
Coal	1 6	4	10

Elevation of coal, 2015' A. T., aneroid measurement.

One mile and a half northeastward, the thickness and character of the Upper Freeport coal in the Baltimore & Ohio Railroad cut at Anderson are exhibited in the Rowlesburg section, page 97.

Southward in the same district, the following section was measured by Reger at the **Lincoln Sidwell and Quinter Reed mine**, on Frog run, 1.4 miles N. 20° W. of Friends Gap:

		Ft.	In.
Sandstone, massive, Mahoning		10	0
Draw slate		0	8
Coal, bony	1' 0"		
Coal, good, hard	2 6		
Shale, dark gray, soft	0 2		
Coal, hard, good	1 6	5	2

Shale

Elevation of coal, 2165' A. T., aneroid measurement.

In the southern edge of Reno, Reger measured the following section at the **Daniel Colebank mine**, located 0.6 mile southeast of Colebank P. O.:

			Ft.	In.
Sandstone, pebbly, Lower Mahoning.....			6	0
Coal, soft	2'	0"	Upper Freeport	
Slate, gray	0	1		
Coal, good	1	3	3	4

Concealed by water

Elevation of coal, 1630' A. T., aneroid measurement.

The two following sections are from commercial mines in the Upper Freeport along the northern edge of the district:

Gorman Coal & Coke Co., Mine No. 1—No. 52 on Map II.

Kingwood district, at West End; **Upper Freeport Coal.**

			Ft.	In.
1. Sandstone, massive, Mahoning				
2. Coal, bony	0'	10"		
3. Coal, soft	2	8		
4. Slate, gray.....	0	2		
5. Coal	1	3	4	11
6. Shale, gray				

Tidal elevation, 1771', spirit level; principal office, No. 900 Continental Bldg., Baltimore, Md.; daily capacity, 100 tons; 25 men employed; horse haulage; shipped east; butts, N. 70° W.; faces, N. 20° E.; greatest rise, east; sample collected from Nos. 3 and 5 of section, in Main Heading, 2nd Left, by D. B. Reger; Thos. Murphy, superintendent, authority for data.

For composition and fuel value of above coal, see **No. 52** in table of analyses at the end of this chapter.

Both the above and the following mine were once sampled by A. P. Brady for the Survey, and the sections and analyses published on pages 409-410 of Volume II of the State Geological Reports.

Merchants Coal Co., Tunnelton Mine—No. 53 on Map II.

Kingwood district, at Tunnelton; **Upper Freeport Coal.**

			Ft.	In.
1. Draw slate				
2. Bone coal	0'	10"		
3. Coal, soft, sulphurous.....	0	7		
4. Coal, soft, good.....	2	3		
5. Shale, gray	0	2		
6. Coal, soft	1	9	5	7
7. Shale, gray				

Tidal elevation, 1872', spirit level; principal office, First National Bank Bldg., Pittsburgh, Pa.; controlled by United Coal Co., Pittsburgh, Pa.; daily capacity, 1000 tons; 90 laborers and 100 miners employed; electric haulage; coal shipped east for general use; butts, N. $75^{\circ} 52'$ W.; faces, N. $14^{\circ} 08'$ E.; greatest rise, northeast; sample collected for analysis from Nos. 4 and 6 of section, in Room No. 20 on 24th Left, off first Main, by D. B. Reger; Thomas Stiff, superintendent, authority for data.

For composition and fuel value of above coal, see **No. 53** in table of analyses at the end of this chapter.

The foregoing data on the Upper Freeport in Reno show the coal to have about the same thickness and character as in Kingwood and Lyon districts, where it is exposed at crop along the eastern border of the field. The thickness and regularity of this bed in the central and western portions of the minable area in Reno are fairly well established, even though it lies below drainage, by the logs of the borings near Fellowsville, Evansville, Dent and Colebank. With the evidence at crop along the north and east borders of Reno, and its presence in minable thickness and purity where it passes below Sandy creek at the common corner of Preston, Taylor and Barbour counties, it tends to the probability that the same conditions prevail throughout all of the Upper Freeport area of this district.

Portland District.

Portland catches a few square miles of the Upper Freeport coal in the Kingwood Basin along its western border, and in the Mount Carmel Basin in the southeastern corner of the district. No commercial mines have yet been opened within its borders on this bed, but, as in other portions of the county, it has been mined by farmers for local domestic fuel. Seven bore holes—Nos. 78 to 84, inclusive—have been sunk to test the coals therein, but the Survey was able to obtain the logs of only Nos. 82, 83 and 84. Nos. 82 and 83 are located on Bearwallow run, 1.5 miles northward from Manheim, and both start below the Upper Freeport coal as shown in the section for the latter place, page 94. No. 84 is located in the southeast corner of the district, and it also starts below the same coal as shown in its record given on a preceding page. Hence, the only data available as to its thickness and regularity are those

obtained from crop exposures and country banks, which will now be given.

In the northwestern edge of Portland district, Reger measured the following section at the **W. I. Lenhart mine**, located 0.4 mile northeast of Hayden:

			Ft.	In.
Sandstone, massive				
Coal, bony.....	0'	8"	Upper	
Coal, good, soft.....	3	8	Freeport	
Shale, gray	0	2	Coal	
Coal, good	1	2		
Shale			5	8
Elevation of coal, 1840' A. T., aneroid measurement.				

Three miles southwestward in the same district, the following section was measured by Hennen at the **Marshall Morgan mine**, located 300 to 400 feet east of the mouth of Muddy creek:

			Ft.	In.
Sandstone, massive			3	0
Shale, dark, gray, sandy.....			4	6
Coal, soft	3'	0"	Upper	
Shale, gray	0	4	Freeport	
Coal, soft	0	7	Coal	
Slate pavement			3	11
Elevation of coal, 1215' A. T., aneroid measurement.				

Just above Albright, this bed emerges from Cheat river, where the following section was measured by Hennen at what is known as the "**Snake Den Bank**," 0.5 mile southeast of Albright:

	Ft.	In.
Sandstone, massive, Mahoning	50	0
Shale, dark, sandy, laminated, Uffington.....	5	0
Coal, soft, Upper Freeport.....	2	7
Slate and concealed to river.....	3	0
Elevation of coal, 1200' A. T., aneroid measurement. -		

On the north hillside of Daugherty run, 0.8 mile eastward from Albright, a sample for analysis was collected and the following section measured by Hennen at an opening in the Upper Freeport vein:

W. H. Sypholt Mine, Upper Freeport Coal—No. 38 on Map II.

			Ft.	In.
1. Slate				
2. Coal	2'	6"		
3. Slate, dark gray	0	2		
4. Coal	0	4	3	0
5. Slate				
Elevation of coal, 1350' A. T., aneroid measurement.				

The composition of the sample from Nos. 2 and 4 only of section, as reported by Messrs. Hite and Krak, is given under **No. 38** in the table of analyses at the end of this chapter.

About $2\frac{1}{2}$ miles southward Reger measured the following section at a mine in this coal, located 1.3 miles southeast of Caddell and 0.3 mile north of the Terra Alta turnpike:

			Ft.	In.
Sandstone boulders, massive, pebbly, and concealed			50	0
Slate, dark			1	0
Coal, soft	1'	1" Upper		
Slate, dark	0	1 Freeport		
Coal, soft, good.....	1	8 Coal	2	10
Shale, gray				
Elevation. 2100' A. T., aneroid measurement.				

In the Mount Carmel Basin region of Portland district, the Upper Freeport coal appears to have thinned down below minable dimensions, its blossom being noted at only one place; viz., along the hill road one mile southwest of Corinth, where Reger reports a coal blossom at an elevation of 2695' A. T., aneroid measurement, 220 feet above the Lower Kittanning bed, in an old air hole, 0.2 mile northeastward.

The foregoing data on this seam in Portland district show the coal not so thick on the east side of Cheat as in the region immediately west, but the Sypholt mine (No. 38) shows it fairly low in ash and sulphur, so that in the Kingwood Basin portion of the district the bed may still be classed as minable.

Union District.

Union district catches a small area of the Upper Freeport coal in the Mount Carmel Basin northeastward from Amboy, and another still smaller tract in the extreme southeastern

point of the district and county, the latter being not over one-half square mile in extent. As in the Corinth region of Portland district, no coal of minable thickness at this horizon was observed in Union. In the Fairfax region the log of Bore Hole No. 3 (104) of the Davis Coal & Coke Co., published on page 259, shows 8 feet of dark shale at this horizon.

Coke From Upper Freeport Coal in Preston.

The Upper Freeport coal in Preston is finely adapted, as mentioned on preceding pages, to the manufacture of high-grade coke for steel and foundry purposes, burned in either beehive or by-product ovens. In the Bretz and Austen regions it has been coked quite extensively in beehive ovens, where samples for analysis were collected by Reger, the compositions of which, as reported by Messrs. Hite and Krak, are given in the table next below:

Coke Analyses.

	No. 1	No. 2	No. 3
	Per cent	Per cent	Per cent
Moisture	0.14	0.32	0.15
Volatile Matter	1.59	2.71	2.02
Fixed Carbon	85.91	81.49	84.57
Ash	12.36	15.48	13.26
Totals	100.00	100.00	100.00
Sulphur	0.38	1.17	0.81
Phosphorus	0.014	0.025	0.067

Explanations of Table:

No. 1—Lab. No. 849H—48-hour coke from the **Preston County Coke Co.**, beehive ovens (194 in number) at Cascade, Preston county. Coal prepared in dry breaker from mines Nos. 1, 2 and 3.

No. 2—Lab. No. 857H—72-hour coke from the **Elkins Coal & Coke Co.**, beehive ovens (267 in number, but only 50 in use in April, 1913), at Bretz, Preston county. Coal prepared in dry breaker from No. 2 (Bretz) mine.

No. 3—Lab. No. 831H—48 hour coke from **Austen Coal & Coke Co.**, beehive ovens (228 in number) near Austen, Preston county.

Samples of coke were once collected by Hennen for the Survey from the ovens of the Preston County Coke Co. and the Elkins Coal & Coke Co. at Cascade and Bretz, and the analyses published on page 586 of Volume II(a) of the State Geological Reports, to which the reader is referred for further

particulars as to the character and quality of coke made from Upper Freeport coal.

The "main bench" and "mining ply" divisions only of this vein are utilized for coke, the "roof" and "bottom" divisions running too high in sulphur, phosphorus and ash to give good results.

Quantity of Upper Freeport Coal Available.

From the foregoing data on the Upper Freeport coal in Preston county, it appears that this bed ranges in thickness from 3 to 6 feet, with some half dozen exceptions noted. Hence, in forming an estimate of the available coal an average thickness of **3 feet** is assumed as spread out over the entire region indicated on Map II. With this assumption and a planimetric determination from the latter map by Reger, the following estimate is made:

District.	Square Miles	Acres	Cubic Feet of Coal	Short Tons of Coal
Grant	36.28	23,220	3,034,389,600	121,375,584
Pleasant	32.68	20,915	2,733,172,200	109,326,888
Valley	32.97	21,100	2,757,348,000	110,293,920
Lyon	26.54	16,985	2,219,599,800	88,783,992
Kingwood	41.91	26,820	3,504,837,600	140,193,504
Portland	13.50	8,640	1,129,075,200	45,163,008
Reno	48.11	30,790	4,023,637,200	160,945,488
Union	0.30	190	24,829,200	993,168
Totals.....	232.29	148,660	19,426,888,800	777,075,552

Probably not over 7,000,000 short tons of this coal have been mined in Preston. This would leave a balance **available** of about **770,000,000 short tons**. In the Bretz region the Elkins Coal & Coke Company, according to J. B. Hanford, Supt., recover 95 to 96 per cent. of their mining section, or 6,500 tons to the acre. This mining section includes only the "main bench" and "mining ply," the "roof" and "bottom" coals being left in the ground, on account of their high ash and sulphur content, except that sufficient fuel to run the boilers at the mines is taken from the "roof" division.

The Lower Freeport Coal.

The thickness and distribution of the Lower Freeport coal have been described in chapter VII. From the data therein, as well as from the logs of the bore holes published on preceding pages of this chapter, as a minable coal, it appears to be confined to Grant and Pleasant districts and possibly a narrow strip along Muddy creek in the northwest edge of Portland. In the region of Clifton Mills, Bruceton and Guseman, where it attains its best development, a thickness of 4 to 5 feet frequently occurs. The analyses (See Nos. 55 and 56 in table at end of this chapter) show this bed too high in ash and sulphur for coking, but care in mining would produce a fair fuel for domestic and steam purposes.

Quantity of Lower Freeport Coal Available.

The area of minable Lower Freeport coal in Grant, Pleasant and Portland districts, as indicated roughly on Map II, ignoring areas in other districts, is about 100 square miles. In forming an estimate of available coal, an assumption of **2 feet** thickness, spread out over the entire 100 square miles, appears conservative. Figuring on this basis, the **available** coal is **223,000,000 short tons.**

The Upper Kittanning Coal.

The Upper Kittanning, described briefly in chapter VII, has been mined by farmers for local domestic fuel at several points in Preston county, but no commercial mines occur. These country banks and sections will now be discussed by districts.



PLATE XXIX.—Showing coke ovens and tipples of the Preston County Coke Company at Cascade.

Photo by E. E. Knight

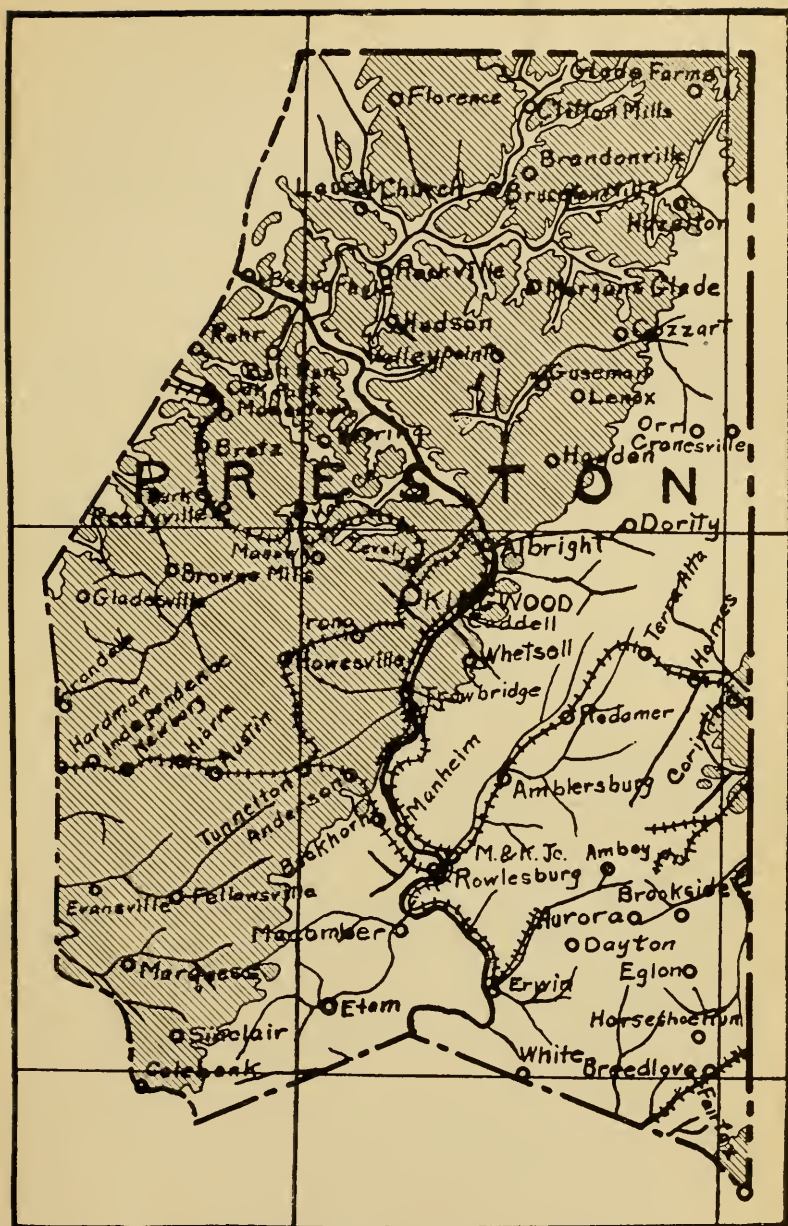


Figure 7.—Showing total area of the Upper Kittanning Coal, over a great portion of which the bed is minable. (See description of vein by magisterial districts in text).

Grant District.

Along the axis of the Ligonier Basin in Grant district, the Upper Kittanning coal was once opened on the east edge of the hill road, 0.8 mile northeast of Laurel Church, at an elevation of 1550' A. T., aneroid measurement, 105 feet below the Upper Freeport vein. The digging had fallen shut, so that a section could not be obtained.

It is the Upper Kittanning that is mined on the west bank of Hazel run, $\frac{3}{4}$ mile southwest of Hopewell Church, at an elevation of 1580' A. T., aneroid measurement, 125 feet below the Upper Freeport coal in the steep hill immediately to the southwest. Separate samples of the upper and lower benches and one of both combined were collected and the following section measured at this mine by Hennen and the results in a modified form, as published on pages 599 and 600 of Volume II(a) of the State Survey Reports, follow herewith:

Thurmond King Mine.—No. 57 on Map II.

		Ft.	In.
1. Sandstone, massive, Lower Freeport, upper division			
2. Coal, good	1' 6"		
3. Slate, black and silicious..	0 6		
4. Coal, good	4 2	6	2
5. Slate bottom			

The composition of the samples, collected as above mentioned, as reported by Messrs. Hite and Patton, is given under **No. 57** in table of analyses at end of this chapter. The results reveal a high grade coal for steam purposes, but it is apparently too high in sulphur and ash to be successfully coked.

Eastward in Grant district, this coal has long been mined for local domestic fuel at Bruceton Mills, at the roadside on the east bank of Big Sandy creek, where a sample was collected and the following section measured:

William Miller Mine.—No. 58 on Map II.

	Ft.	In.
1. Sandstone		
2. Slate, black	0	10

			Ft.	In.
3. Coal, hard	0'	3 "		
4. Slate, black, hard.....	0	2		
5. Coal, soft	0	4½		
6. Coal, bony.....	0	2		
7. Coal, soft	1	6		
8. Slate, black	0	1½		
9. Coal, soft	1	5		
10. Slate, black	0	1½		
11. Coal, bony	0	5	4	6½
12. Slate pavement				
Elevation of coal, 1540' A. T., aneroid measurement.				

The composition of the sample from only Nos. 7 and 9 of section is given under **No. 58** in table of analyses at end of this chapter.

A glance at Map II and Figure 7 shows the Upper Kittanning coal below drainage over the most of Grant district lying east of Big Sandy creek and north of Little Sandy. In this region, the North Preston Coal Company has sunk 13 borings—Nos. 8 to 12, 14 and 21 to 27, inclusive, on Map II—which should test the thickness and regularity of this coal, but the latter refused to furnish the Survey any information concerning these wells.

Pleasant District.

In Pleasant, the Upper Kittanning has apparently the same development as in Grant district, and has been opened at several country banks by farmers for domestic fuel.

A sample for analysis was collected and the following section measured by Hennen at a mine located on the south bank of Little Sandy creek, 1.5 miles due south of Bruceton Mills:

J. F. Loraw Mine.—No. 59 on Map II.

			Ft.	In.
1. Slate				
2. Coal, bony	0'	9"		
3. Coal, soft	2	1		
4. Slate, black, sulphurous, hard	0	2		
5. Coal, soft	1	4		
6. Slate, black, sulphurous, hard	0	1		
7. Coal, harder	6" to 0	8	5	1
8. Slate and flaggy sandstone				
Elevation of coal, 1565' A. T., aneroid measurement.				

The composition of the sample from only Nos. 3 and 5 of above section, as reported by Messrs. Hite and Krak, is given under **No. 59** in table of analyses at the end of this chapter. No. 7 is left unmined in rooms, but the coal is fairly pure. The results show the two benches sampled to be high grade coal, sufficiently low in ash and sulphur for the manufacture of both furnace and foundry coke.

On the same side of Little Sandy, $\frac{1}{4}$ mile northeastward, Reger measured the following section at the **Evan King mine**:

			Ft.	In.
Concealed				
Sandstone, massive			10	0
Coal, soft .. .	0'	4 "		
Slate, gray.....	0	2		
Coal, soft	2	0		
Slate, gray and hard.....	0	0 $\frac{1}{2}$		
Coal, soft	1	4 $\frac{1}{2}$		
Shale, gray	0	1		
Coal	0	5	4	5

Shale, gray

Elevation of coal, 1595' A. T., spirit-level measurement.

Two and a half miles westward, it is the Upper Kittanning coal that was once opened on the land of **O. Y. Shaw**, one-third mile south of the mouth of Little Sandy, at an elevation of 1613' A. T., spirit-level measurement. The entry had fallen shut so that a section could not be obtained when visited in 1912.

Passing to the eastern edge of the coal field in the district, the following section is exposed, according to Hennen, at the **Cyrus Shafer opening**, located 2.1 miles N. 5° E. of Cuzzart at the cross-roads on a branch of Beaver creek:

			Ft.	In.
Sandstone, massive, pebbly, Lower Freeport....			40	0
Coal	1'	5"		
Slate	0	1		
Coal	1	0	2	6

Slate

Elevation of coal, 1995' A. T., aneroid measurement.

The mine had fallen shut so that a full section could not be obtained by direct measurement, but the coal section as given above is from information furnished by Mr. J. M. Smith, a local resident.

A glance at Map II and Figure 7 shows that the main body of the Upper Kittanning coal in Pleasant district lies below drainage where its thickness and regularity can only be determined by the drill. Seventeen borings—Nos. 18 to 33, inclusive, on Map II—have been sunk within the area, but the Survey was able to obtain the logs of only seven (See table, pages 220-221), none of which gives any information on this bed, as they either begin below its crop, or fail to reach its depth where they start above it. Hence, owing to the irregularity of this vein, a number of test borings will have to be drilled through the same to determine its purity and persistence in this portion of Pleasant district.

Valley District.

The Upper Kittanning coal attains fair development in some portions of Valley district and at other points appears to be missing entirely. In the northern part of this area, samples for analysis were collected and the following section measured at a country bank in this bed:

Joseph W. Feather Mine.—No. 60 on Map II.

			Ft.	In.
1. Slate, dark gray.....			1	8
2. Coal cannelly	1'	1" Upper Kittan-		
3. Coal, soft	2	7 ning Coal..	3	8
4. Slate, dark, and concealed.....				
Elevation of coal, 2170' A. T., aneroid measurement.				

The composition of a separate sample from each bench, as reported by Messrs. Hite and Krak, is given under No. 60 in the table of analyses at the end of this chapter. Both reveal a high percentage of ash.

About 2.5 miles southwestward the following section was measured, by Hennen at the James Fields mine, located $\frac{1}{2}$ mile S. 40° W. of Kanawha Creek station:

			Ft.	In.
Slate				
Coal, bony	1'	1 "		
Coal, soft	1	2 Upper		
Coal, bony	0	3 Kittanning		
Coal, soft	1	4 Coal		
Slate, gray	0	1½		
Coal	1	2	5	1½
Fire clay, good, Upper Kittanning.....			1	0
Concealed				
Elevation of coal, 2000' A. T., aneroid measurement.				

At the above opening the base of the Lower Mahoning sandstone comes 100 feet higher on the steep hill slope directly northwestward.

It is the Upper Kittanning coal that crops in the Morgantown & Kingwood R. R. cut, $\frac{1}{2}$ mile southward from Kanawha Creek station, where the following section was measured by Hennen:

			Ft.	In.
Sandstone, flaggy, Lower Freeport.....			3	0
Slate, black			1	0
Coal, bony	0' 9 "	Upper		
Coal, soft	3 0	Kittanning		
Shale, gray	0 1½	Coal		
Coal	9 10		4	8½
Fire clay, good, Upper Kittanning.....			9	0
Elevation of coal, 2075' A. T., aneroid measurement.				

Northwestward on Bull run, this vein has thinned below minable dimensions as revealed in the following section measured by Hennen at its crop in the public road, $\frac{3}{4}$ mile southwest of Bull Run P. O.:

	Ft.	In.
Upper Freeport coal horizon.....		
Interval, estimated	65	0
Sandstone, massive	10	0
Shale and sandstone, shaly.....	35	0
Shale, dark	10	0
Coal, Upper Kittanning	1	0
Shale and concealed to Bull run.....	7	0
Elevation of coal, 1385' A. T., aneroid measurement.		

The Elkins Coal & Coke Co. has sunk 18 borings (See table, pages 220-221) within the district, mostly to test the Upper Freeport bed. The Survey, through the courtesy of J. B. Hanford, superintendent, was able to obtain the logs of all these borings (Nos. 36 to 54 on Map II), the details of which are published on preceding pages. Only Nos. 37, 42 and 48 penetrated deep enough to test the Upper Kittanning, and all three show it either absent or thinned below workable dimensions in the Masontown-Burk region of the Ligonier Basin.

Lyon District.

In Lyon the Upper Kittanning coal attains fair development along the western slope of the Ligonier Basin. A glance at Map II shows that its crop is confined to the western edge

of the district, so that the only data available to test its thickness and regularity in the central and eastern portions are the logs of bore holes (Nos. 61 to 73, inclusive, on Map II), the details of those which were obtained being published on preceding pages of this chapter. The Survey was unable to get the logs of Nos. 61, 64 and 71, while Nos. 72 and 73 did not penetrate deep enough to reach this bed. Nos. 63, 65, 66, 70 and 72 show it either absent or too thin to be mined. Its thickness and character at country banks will now be discussed.

A sample for analysis was collected and the following section measured at a mine located on the east bank of Brains creek, 0.9 mile southwest of Browns Mills:

Hamilton Coal Company—No. 61 on Map II.

			Ft.	In.
1.	Sandstone, massive, Lower Freeport.....			
2.	Coal, soft 1'	8"		
3.	Slate, dark, gray.....0	1	Upper	
4.	Coal 0	11	Kittanning	
5.	Shale, gray 0	4	Coal	
6.	Coal 0	6	3	6
7.	Shale, sandy, to creek bed.....	10	0	
Elevation of coal, 1530' A. T., aneroid measurement.				

For analysis of sample from Nos. 2 and 4 only of section, see **No. 61** in table of analyses at the end of this chapter.

The two mines represented by the following data are located along the western edge of Lyon, 5½ miles southwest of the opening last described:

L. B. Brydon, Prospect Opening.—No. 62 on Map II.

Lyon district, 0.8 mile S. 10° W. of Irondale; Upper Kittanning Coal.

			Ft.	In.
1.	Slate, black, visible	1	0	
2.	Coal, soft 1'	1"		
3.	Slate, gray.....0	1		
4.	Coal, soft 1	3		
5.	Slate, gray.....0	2		
6.	Coal, slaty 0	6	3	1
7.	Shale, gray			

Tidal elevation, 1215', aneroid; prospect opening; never operated; sample collected for analysis from Nos. 2 and 4 at end of main prospect heading 15' from mouth, by D. B. Reger.

For analysis and fuel value of sample, as reported by Messrs. Hite and Krak, see No. 62 in table of analyses at end of this chapter.

Irvington-Late Coal Co., Prospect Opening.—No. 63 on Map II.

Lyon district, 1.1 miles S. 10° W. of Irondale; Upper Kittanning Coal.

			Ft.	In.
1.	Slate, black			
2.	Coal, good.....1'	0½"		
3.	Slate, gray	1½		
4.	Coal	1 7	2	9
5.	Shale			

Tidal elevation, 1160' aneroid; sample collected for analysis from Nos. 2 and 4 of section by D. B. Reger.

For analysis and fuel value of above coal, see No. 63 in table of analyses at end of this chapter. The calorific tests show this seam running 600 to 700 British Thermal Units lower per pound of coal in Preston than the Upper Freeport bed.

Reno District.

A glance at Map II shows that the Upper Kittanning coal lies entirely below drainage in the western half of Reno and that its crop is confined to an irregular line running southwest from Anderson on the Baltimore & Ohio R. R. to near the common corner of Barbour, Tucker and Preston counties, along the western slope of Laurel Ridge mountain. No exposures or diggings along this crop line were observed in the district; hence, the only source of information as to its thickness and character where its horizon remains uneroded is the logs of borings (See table, pages 220-221) sunk to test it and lower coals. As appears on preceding pages from the records of Nos. 89, 91 and 91A, this coal is absent entirely from the measures in the vicinity of Evansville, Dent and Fellowsville. West and northwest of Colebank, the logs of borings Nos. 94 and 95, just in the edge of Barbour, exhibit only 30 inches of shale and coal mixed at the horizon of the Upper Kittanning. Hence, it is quite problematical whether or not the latter coal as a minable bed has much areal extent in Reno district.

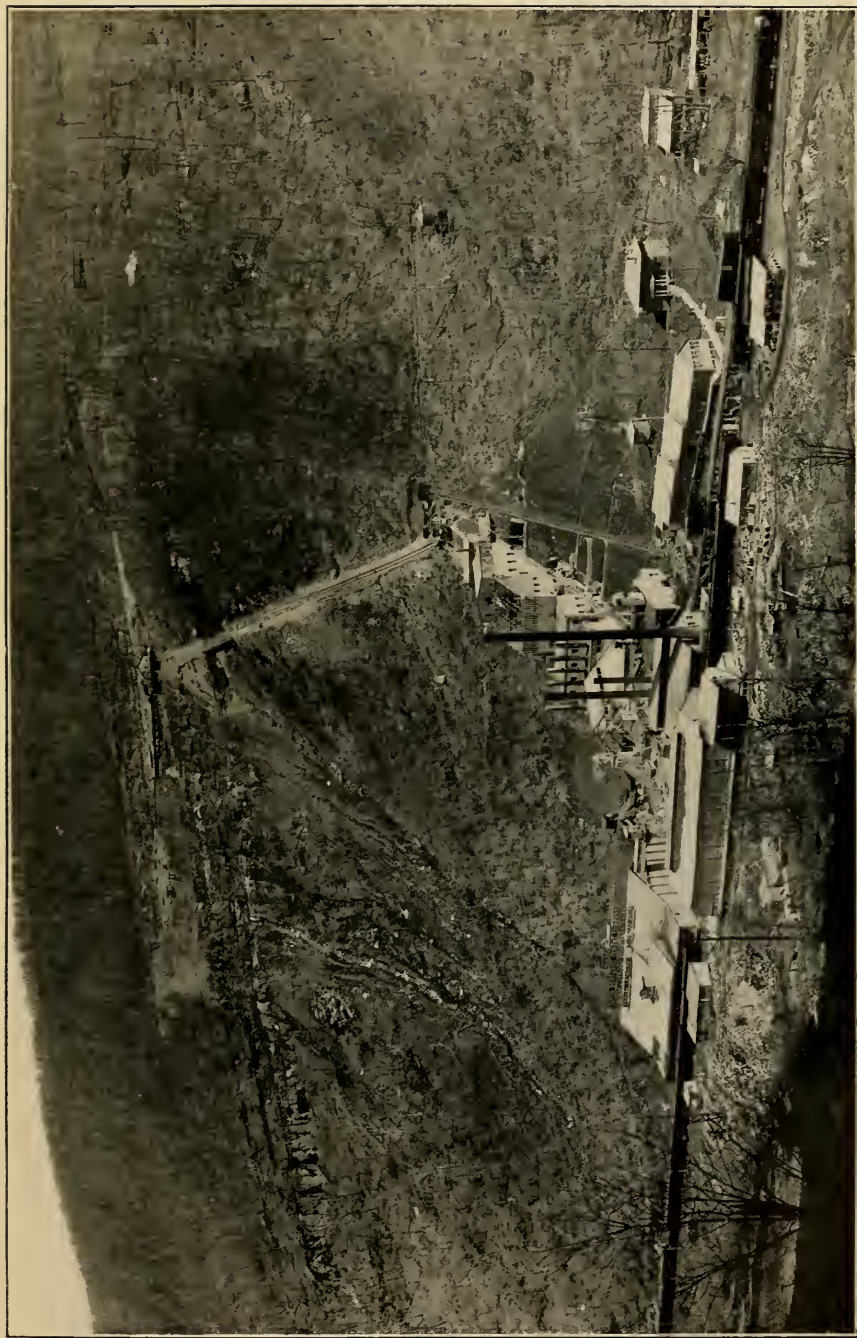


PLATE XXX.—Manheim No. 5 Plant of the Alpha Portland Cement Co. at Manheim, and quarry in Greenbrier Limestone (See Text). Photo by E. E. Knight
Outcropping rocks in the Catskill, Pocono, Greenbrier, Manch Chunk and Pottsville.

Kingwood District.

Map II and Figure 7 show the Upper Kittanning coal covering almost the entire area of Kingwood district and cropping in a very limited area along the northern and eastern edges of the district. Referring to the tabulated list of borings, it is readily observed that the most of those obtained for the latter area did not penetrate deep enough to catch this vein, the exception being W. G. Brown No. 12 (No. 74B on Map II), which reports about 2 feet of impure coal at this horizon. Hence, not much is known as to its thickness and character over most of the district.

The following section was measured by Hennen at the crop of this bed in the railroad cut at Manown station:

			Ft.	In.
Sandstone, gray, medium grained, micaceous, massive and broken at bottom, Lower Freeport			30	0
Coal, soft.....0'	11"	Upper Kittanning Coal.....		
Bone	1			
Coal, soft	6			
Slate, dark gray, with coal streaks	7		2	6
Coal	5			
Fire clay, sandy, and shale to railroad grade.....			5	0
Elevation of coal, 2161' A. T. spirit-level measurement.				

The above coal comes 80 feet, spirit-level measurement, below the William Miller bank in the Upper Freeport coal, the latter being slightly westward down the dip from Manown. At one point in the cut above mentioned the Upper Kittanning is pinched away entirely.

Passing to the eastward edge of the district, the following section is exposed, according to Hennen, at the crop of the Upper Kittanning along the Morgantown & Kingwood Railroad grade, 1 mile southeast of Albright:

			Ft.	In.
Sandstone, massive, Lower Freeport.....			20	0
Shale, reddish, broken.....			7	0
Slate, gray, blocky.....			0	6
Coal, soft.....2'	4 "	Upper Kittanning Coal		
Coal bony	6½			
Slate, black	2			
Coal, bony	2		3	2½
Shale, sandy			0	8
Limestone, nodular, feriferous, Johnstown				
Cement			1	0
Elevation of coal, 1260' A. T., aneroid measurement.				

In the southern edge of Kingwood district, the crop of this coal is exposed along the Baltimore & Ohio R. R. grade, 0.4 mile southeastward from Anderson, at an elevation of 1840' A. T., aneroid measurement. Its detailed section at this point is given in the Rowlesburg section, page 97, which shows only 13 inches of coal in a total section of 32.

The foregoing data for the Upper Kittanning coal in Kingwood district exhibit this bed in poor development at the points noted. Before condemning the latter area for this seam, several test borings should be sunk south and west of its crop therein.

Portland District.

Portland district catches a few square miles of the Upper Kittanning coal along its northwest border in the Kingwood Basin and a still smaller area in the Mount Carmel syncline, northeastward from Amboy to the Maryland line. In the former region six borings have been sunk to test the coals where they lie below drainage, but the Survey was able to obtain the logs of only two—Nos. 82 and 83—both of which start below this seam, as will be observed in the Manheim section, page 94. In the Corinth region, only one test—No. 84—has been drilled, the record of which is also given on a preceding page. In the latter the Upper Kittanning evidently belongs in the 134 feet of "unrecorded" interval at the top, and if any coal had been present at this horizon, it would very probably have been noted by the driller. Another evidence that this bed does not occur in minable dimensions in the Corinth region of the Mount Carmel synclinal is the fact that it was not observed at several points where its horizon was exposed at crop.

Passing to the northwestern edge of the district where the minable area, if any, of this seam therein must be confined, the following section was measured by Reger, on the land of **Thomas Dunn**, at an exposure of the Upper Kittanning, $\frac{1}{2}$ mile southeast of St. Joe:

	Ft.	In.
Shale, gray sandy	10	0
Coal, good, Upper Kittanning.....	1	8
Slate, black	1	0
Shale, gray, with nuggets of ferriferous limestone	15	0
Shale, sandy and dark.....	30	0
Fire clay, flint, Hardman.....	10	0

Elevation of coal, 1345' A. T., aneroid measurement.

The above data are very meager on which to form an opinion of the thickness and regularity of the Upper Kittanning coal in Portland district. The logs of bore holes Nos. 78, $\frac{1}{2}$ mile southwest of Hayden; No. 80, 1.4 miles eastward from Caddell; and No. 81, $\frac{3}{4}$ mile southeast of Trowbridge Ferry bridge, probably would shed some light on the subject. It is probable that it holds a thickness of at least 2 feet over most of that portion lying in the Kingwood Basin outlined for this bed therein on Figure 7.

Union District.

Map II and Figure 7 show two small areas of the Upper Kittanning coal in Union district; viz., along the axis of the Mount Carmel Basin for 1 to 2 miles southwest of the Portland-Union district line, and a much smaller tract in the extreme southeastern point of the county. For reasons given above under the discussion of Portland district, it is not believed that any of this coal of workable thickness occurs in the former locality. There is a probability that the same conditions occur in the southeastern point of the district since the detailed log of Bore Hole No. 3 (No. 104 on Map II), published on page 259, shows the absence of this seam. No exposures of the coal were observed in the last mentioned region.

Quantity of Upper Kittanning Coal Available.

A careful study of all the foregoing information on the Upper Kittanning in Preston county as outlined on Map II and Figure 7 shows that it varies greatly in thickness even in those districts where it reaches its best development. For the purpose of forming an estimate for the whole county of the available tonnage, it is believed that the assumption of an average thickness of 18 inches spread out over the indicated area on Figure 7 would be conservative. Figuring on this basis, with the aid of a planimetric determination by Reger from the map mentioned, the following results are obtained:

District	Square Miles	Acres	Cubic Feet of Coal	Short Tons of Coal
Grant	60.87	38,955	2,545,319,700	101,812,788
Pleasant	52.39	33,530	2,190,850,200	87,634,008
Valley	46.67	29,870	1,951,705,800	78,068,232
Lyon	40.44	25,880	1,690,999,200	67,639,968
Kingwood	55.32	35,405	2,313,362,700	92,534,508
Portland	16.86	10,790	705,018,600	28,200,744
Reno	51.61	33,030	2,158,180,200	86,327,208
Union	0.64	410	26,789,400	1,071,576
Totals	324.80	207,870	13,582,225,800	543,289,032

It should not be taken for granted that a thickness of 18 inches at least occurs on this indicated area, in fact, it is quite doubtful if this coal in minable dimensions and purity exists in a very large portion of even the indicated area of Reno district. However, the excess over 18 inches in some districts may make up the deficiency in this region, so that the figures given above are very much better than a mere guess.

The Lower Kittanning Coal.

The Lower Kittanning coal, described briefly on pages 173 and 174, ranks next to the Upper Freeport as the most valuable vein in Preston county, where it has been mined quite extensively both by farmers for local domestic fuel and by commercial operations along the main line of the Baltimore & Ohio Railroad. Its character at these several openings will now be discussed by districts.

Grant District.

Grant holds a greater area of Lower Kittanning coal than any other district in Preston county (see Figure 8 and Map II), but owing to lack of railroads, no commercial mines occur on this vein therein. However, it has been opened at several country banks by farmers for local domestic fuel, giving highly satisfactory results. Fifteen bore holes have been drilled in the district to test the different coal veins, but the Survey was able to obtain the logs of only four (See table of borings, pages 220 and 221), and only one—No. 6 on Map II—gives any information concerning this bed, showing its absence from the

measures as will be noted in examining the Brandonville section, page 80. Four miles southwestward only 2 feet of coal is reported at this horizon in the log of the M. A. Wolfe well (No. 20 on Map II), a churn drill boring for oil and gas, the record of which is given on page 204. The Lower Kittanning, like all the Allegheny coals in this region, appears very irregular, ranging in thickness from 0 to 8 feet.

In the northwestern corner of the district, the following section was obtained by Reger on the authority of Mr. C. F. Spiker at the **Lewis Foreman mine**, located on the waters of Laurel run, 0.4 mile west of Florence:

			Ft.	In.
Sandstone, massive				
Coal	2'	0"		
Slate, coaly	1	0		
Coal	1	0		
Slate, hard and black...	2" to 0	3		
Coal	0	10	5	1
Slate				
Elevation of coal, 1790' A. T., aneroid measurement.				

The above opening had fallen shut so that a section by direct measurement could not be obtained.

In the southern edge of Grant district, the following section was measured at a digging in this bed, located on the east side of the hill, $\frac{1}{4}$ mile northward from the mouth of Laurel run, and $1\frac{1}{4}$ miles northward from Rockville:

			Ft.	In.
Slate, black			3	0
Coal	8" to 0'	10"		
Shale and fire clay.....	3	0		
Coal	0	11	4	9
Fire clay, Lower Kittanning, reported.....	0'		8	0
Sandstone, Clarion, forming cliff.....				
Elevation of coal, 1520' A. T., aneroid measurement.				

A sample for analysis was collected and the following section measured by Reger at a country bank in this coal, located on the north bank of Glade run, 2 miles northeast of Brandonville:



Figure 8.—Showing total area of the Lower Kittanning Coal, over the greater portion of which the bed is minable. (See description of vein by magisterial districts in text).

Alexander Fike Mine.—No. 64 on Map II.

1. Steep bluff, sandstone.....	30	0
2. Shale, dark	1	0
3. Coal, soft	1' 0"	
4. Slate, black	0 3	
5. Coal, soft	0 11	
6. Shale, gray	0 8	
7. Coal, slaty	0 3	Lower
8. Shale, gray	2 0	Kittanning
9. Sandstone, flaggy	0 6	Coal
10. Shale, dark	3 0	
11. Coal, soft	2 4	
12. Shale, gray and hard....	0 6	
13. Coal, slaty	0 4	11 9
14. Shale, gray and hard.....	1	6
Elevation of coal, 1745' A. T., aneroid measurement.		

Only No. 11 of the above section is mined, the composition of which, as reported by Messrs. Hite and Krak, is given under No. 64 in table of analyses at end of this chapter. The results reveal a high grade coal, being low in both ash and sulphur.

Passing southeastward to the southern edge of the district, the following section is exposed, according to Hennen, at an abandoned opening in this vein, located on the west bank of Cherry run, $\frac{1}{2}$ mile due north of Hazelton:

	Ft.	In.
Sandstone, flaggy	3	0
Shale, dark, gray and sandy.....	3	0
Slate, black	2	0
Coal, soft	1' 1"	Lower Kittan-
Coal, bony and slaty.....	1 1	ning Coal
Coal, soft	0 10	3 0
Slate and concealed by water in mine.....		
Elevation of coal, 1850' A. T., aneroid measurement.		

One mile eastward from Hazelton, the following section was measured by Hennen at the Joseph Spiker mine:

	Ft.	In.
Slate		
Coal, soft	1' 7 "	
Slate, gray	0 2½	
Coal, soft	0 7	
Shale, gray and hard.....	1 6	Lower
Coal, slaty	0 4	Kittanning
Coal, hard	0 8	Coal
Bone	0 1	
Coal, bony	2 0	6 11½
Fire clay, pavement		
Elevation of coal 2150' A. T., aneroid measurement.		

The elevations of this coal at the last two mines demonstrate the rapid rise of the strata in this region on the western slope of the Briery Mountain anticline.

The foregoing sections from crop exposures in Grant district show this seam carrying several slate layers, the whole having a thickness about equal to the total coal.

As mentioned on a preceding page, the North Preston Coal Co. has drilled several borings in the eastern portions of Grant and Pleasant districts (See Map II), the records of which the Survey was unable to obtain. These would throw considerable light on the persistence of the Lower Kittanning coal where it lies below drainage. According to the Secretary of the latter company, the results of these tests were not very satisfactory; hence, it is very probable that this bed lives up to its reputation for irregularity in thickness and purity in the northern half of Preston county.

Pleasant District.

Pleasant district ranks next to Grant in square miles of the Lower Kittanning coal bed within its borders, but a glance at Map II and Figure 8 shows that its crop is confined to the deep gorges of Cheat river and Big Sandy creek on the west, and to an irregular line extending southwestward from Hazelton to near Lenox, on the east. At no point in either locality was an opportunity offered to measure a section of this vein either at diggings or exposures, so effectually was its horizon generally concealed by debris. Where it lies below drainage in the intermediate region, 13 coal test borings have been drilled, as will be observed from the table, pages 220 and 221. Those of the North Preston Coal Co., Nos. 21 to 25, inclusive, on Map II, the records of which the Survey was unable to obtain as mentioned above under the discussion of this coal in Grant district, are all located along the northern edge of Pleasant, westward from Hazelton; while those drilled by the Elkins Coal & Coke Co., Nos. 27A to 32, inclusive, the logs of which, except Nos. 28A and 33, are given on preceding pages of this chapter, are all grouped along the southeast border of the field. A glance at the records of the last mentioned wells shows that none of these borings penetrated deep enough to test the Lower Kittanning coal.



PLATE XXXI.—Lime Kiln ready to burn on farm of J. W. Parks near Eglen. Greenbrier Limestone is mixed with Lower Kittanning Coal in the proportion of 3 bu. of limestone to 1 of coal.

Photo by E. E. Knight

It follows that the data are very meager on which to base an opinion on the thickness, character and minable distribution of this bed in Pleasant district, but it is believed by the authors that practically the same conditions prevail as mentioned above for Grant, in that its reputation in northern Preston for irregularity in thickness and character is still maintained.

Valley District.

A glance at Map II and Figure 8 shows a large area of the Lower Kittanning coal in Valley district and that its crop is confined to near the crest of the Chestnut Ridge anticline on the west; the Cheat River gorge on the northeast; and a small area near Kanawha station, a short distance west of the crest of the Preston anticline. In the intermediate region where it lies at varying depths below drainage, the Elkins Coal & Coke Co. has drilled 18 coal test borings, the summarized records of all of which are given in the table, pages 220-1, followed by detailed logs of the same wells. These are grouped in the Masontown-Reedsville region along both slopes of the Ligonier Basin, and only three—Nos. 37, 42 and 48—penetrated deep enough to test the Lower Kittanning coal, and only in the latter does it attain minable thickness, and there it is bony and impure.

In the southern edge of Valley district, the Merchants Coal Co. sank 6 coal test borings—Nos. 55 to 60, inclusive, on Map II—which probably would throw some light on the persistence of this coal, but the Survey was unable to obtain the records of these wells.

A sample for analysis was collected and the following section measured by Hennen at a country bank in this coal, located on the north edge of the public road, 1.8 miles west of Bretz:

White Mine.—No. 65 on Map II.

			Ft.	In.
1.	Slate			
2.	Coal, bony	0' 5" Lower		
3.	Coal, soft	3 0 Kittanning		
4.	Slate, dark gray.....	2 2 Coal		
5.	Coal, soft	1 2	6	9
6.	Fire clay, Lower Kittanning.....			
	Elevation of coal, 1980' A. T., aneroid measurement.			

Since only Nos. 2 and 3 of the above section had been driven under cover, the sample was collected from the latter, the composition of which, as reported by Messrs. Hite and Krak, is given under **No. 65** in the table of analyses at the end of this chapter. The results show the coal remarkably low in sulphur, but fairly high in ash, the latter being largely due to the crop conditions prevailing at this digging.

Three-tenths mile southward the same coal was once opened on the Sterling farm, but no section was measured at this digging.

Passing southwestward $3\frac{1}{4}$ miles, the following section is exposed at the **W. H. Smith mine**, located on the north edge of the public road, $\frac{1}{2}$ mile east of the Monongalia-Preston county line:

			Ft.	In.
Concealed				
Concealed, containing coal....	2'	0"	Lower	
Coal	0	5	Kittanning	
Fire clay, soft.....	3	0	Coal	
Coal, good	3	0		8 5
Fire clay and concealed			40	0
Sandstone, Homewood, cliff rock here.....				
Elevation of coal, 1925' A. T., aneroid measurement.				

One mile and a quarter southeast of the last digging described, the following section was measured at the **Jerome Kelly mine**, located just north of the road fork on the Valley-Lyon district line:

			Ft.	In.
Sandstone, gray			8	0
Shale, gray			2	0
Coal	0'	5 "		
Slate	0	9½		
Coal	0	9		
Shale, gray	0	7½		
Coal	0	8	Lower	
Shale, gray	1	0	Kittanning	
Coal	0	6	Coal	
Shale, gray, with coal streaks	1	6		
Coal	1	10		
Shale, gray	½" to 0	1		
Coal	0	10	8	3
Slate				
Elevation of coal, 1725' A. T., aneroid measurement.				

No exposures of the Lower Kittanning vein were observed in the Cheat River gorge portion of Valley district, owing to the fact that its horizon is quite effectually concealed by debris.

The foregoing data shows the Lower Kittanning coal in the latter area to occur in good development high up on the eastern slope of the Chestnut Ridge anticline, but having a tendency to thin away as the axis of the Ligonier Basin is approached, as shown in the logs of the three bore holes—Nos. 37, 42 and 48 on Map II—above mentioned. Eastward on the slopes of the Preston arch, it appears to have thickened up, since 4 feet of clean coal is reported at the **Jas. A. Brown mine**, located $\frac{1}{2}$ mile southwest of Manown station, this digging being in the northwest edge of Kingwood district. Sufficient information has been obtained to warrant the assertion that it attains about the same development as in Grant and Pleasant, maintaining its reputation therein for irregularity.

Lyon District.

The Lower Kittanning coal attains a fine development in Lyon district and has been mined on a commercial scale quite extensively along the Baltimore & Ohio Railroad, north of Hardman and at Newburg. A glance at Map II and Figure 8 shows its crop confined to a small area northwest of Gladesville and at Irondale. In that region to the eastward where it lies at varying depths below drainage, ten coal test borings (See table, pages 220-1) have been drilled, the records of all of which, except Nos. 61, 64 and 71, are given on preceding pages of this report. No. 73 did not penetrate deep enough to test the Lower Kittanning, but the other six, except No. 72, show a good thickness of this coal.

In the northwestern corner of the district, the following section was measured by Reger at an opening in this vein, located on the southwest edge of the public road, 1.5 miles northward from Gladesville:

			Ft.	In.
Coal, bony	2'	0"	Lower Kittanning Coal	5
Shale, gray	0	11		
Coal, good	2	9		

Shale, gray

Elevation of coal, 1825' A. T., aneroid measurement.

On the east edge of the Morgantown & Beverly turnpike, 1.3 miles northwest of Gladesville, Reger measured the following section at a mine in this bed:

			Ft.	In.
Shale, gray				
Coal, soft	1'	8"	Lower Kittanning Coal	
Shale, gray	0	4		
Coal, good	1	8		
			3	8
Slate				
Elevation of coal, 1805' A. T., aneroid measurement.				

Its thickness, character and composition along the western edge of Lyon district at the commercial mines will now be described:

L. B. Brydon, Sunnyside Mine.—No. 66 on Map II.

Lyon district, 0.8 mile, S. 10° W. of Irondale; **Lower Kittanning Coal.**

			Ft.	In.
1. Slate, black				
2. Coal, slaty	0'	1 "		
3. Coal, good	0	9½		
4. Slate, black	0	1		
5. Coal	0	6		
6. Sandstone	0	5		
7. Coal, gray	0	5½		
8. Bone coal	2" to 0	4		
9. Coal	2	7	5	3
10. Shale				

Tidal elevation, 1145', aneroid; principal office, Grafton, W. Va.; daily capacity, 100 tons; 7 laborers and 15 miners employed; rope haulage; greatest rise, northwest; sample collected for analysis from Nos. 3, 5, 7 and 9 of section in Straight Heading, by D. B. Reger; T. E. Chidester, authority for data.

For analysis and fuel value of above sample, see No. 66 in table of analyses at the end of this chapter.

Irvington-Late Coal Co., Irving Mine No. 1.—No. 67 on Map II.

Lyon district, 0.9 mile south of Irondale; **Lower Kittanning Coal.**

			Ft.	In.
1. Slate, black				
2. Coal, good	1'	0 "		
3. Bone coal	0	3		
4. Coal, soft	2	10		
5. Shale, gray	0	5½		
6. Coal	0	7½	5	2
7. Shale, gray				

Tidal elevation, 1120', aneroid; daily capacity, 60 tons; 4 laborers and 10 miners employed; rope haulage; coal shipped east; butts, N. 70° W.; faces, N. 20° E.; greatest rise, northwest; sample collected for analysis from Nos. 2 and 4 of section in Room No. 3 off Main Heading, by D. B. Reger; J. H. Irving, general manager, authority for data.

For analysis and fuel value of above sample, see No. 67 in table of analyses at end of this chapter.

L. B. Brydon, Sunnyside No. 2.—No. 68 on Map II.

Lyon district, 1.2 miles S. 10° W. of Irondale; Lower Kittanning Coal.

			Ft.	In.
1. Shale	.....			
2. Coal	1' 7 "			
3. Shale	1 1			
4. Coal	0 7			
5. Slate, black	0 11			
6. Coal, soft	2 4			
7. Slate	0 0 $\frac{1}{4}$			
8. Coal	0 6 $\frac{1}{2}$	7	0 $\frac{3}{4}$	
9. Slate	.....			

Tidal elevation, 1110', aneroid; principal office, Grafton, W. Va.; mine not yet in operation; butts, N. 78° W.; faces, N. 12° E.; greatest rise, northwest; horse haulage; sample No. 859H collected from Nos. 6, 7 and 8 of section in Main Heading, by D. B. Reger; Joseph Brad-dock, foreman, authority for data.

For analysis and fuel value of above sample, see No. 68 in table of analyses at end of this chapter.

Preston Fuel Co. (Shaft) Mine.—No. 69 on Map II.

Lyon district, 0.2 mile southwest of Independence; Lower Kittanning Coal.

			Ft.	In.
1. Slate	.....			
2. Coal	1' 8" }			
3. Slate	0 8 }			
4. Coal	0 11 }	8	2	
5. Bone	0 2 }			
6. Coal	4 9 }			
7. Slate pavement	.....	0	4	
8. Coal, reported	.....	1	3	

Tidal elevation, 945', aneroid; principal office, Pittsburgh, Pa.; president's office, West End Trust Bldg., Philadelphia, Pa.; mine just started; coal is to be used for fuel on B. & O. R. R.; sample No. 858H collected from Nos. 4 and 6 of section in Air Course, by D. B. Reger.

For analysis and fuel value of above sample, see No. 69 in table of analyses at end of this chapter.

The foregoing is a shaft mine, the depth to the Lower

Kittanning coal being accurately shown in the log of Bore Hole No. 65 at this point, published on page 242.

Virginia-Maryland Coal Corporation, Scotch Hill Mine.—No. 70 on Map II.

Lyon district, at Newburg; Lower Kittanning Coal.

		Ft.	In.
1. Slate, dark			
2. Coal, good	0'	11"	
3. Slate, dark	0	10	
4. Coal, soft	0	8	
5. Coal, hard, bony	0	2	
6. Coal, soft, columnar.....	5	2	
7. Shale, gray	1	0	
8. Coal	4" to 0	6	9 3
9. Slate, black, very hard, pavement.....			

Only No. 6 of section is mined.

Tidal elevation 858', spirit level; principal office, 104 Marine Bank Bldg., Baltimore, Md.; nominal capacity, 1000 tons; production, 50 or 60 tons; mine being repaired; 58 laborers and 10 miners employed; mule haulage; coal shipped east for steam; butts, N. 75° W.; faces, N. 15° E.; greatest rise, S. 15° E.; sample collected for analysis from No. 6 of section in South Main Heading, outside of 2nd Butt, by D. B. Reger; L. C. Stevenson, superintendent, authority for data.

For analysis and fuel value of above sample, see No. 70 in table of analyses at end of this chapter.

The last is one of the oldest shaft mines in the State, and it was once the scene of a disastrous mine explosion which caused its temporary abandonment. The position of the coal in the rock column is exhibited in the Newburg section, page 89.

The analyses and fuel tests on the foregoing mines in Lyon district reveal a high grade coal, Nos. 68, 69 and 70 comparing favorably with the Upper Freeport vein in the Bretz region.

Reno District.

The Lower Kittanning coal in Reno is confined to the western half of the district and its crop, as indicated on Map II and Figure 8, to an irregular line extending southwestward from near Anderson to an intersection with the Preston-Barbour county line, 1 mile southeast of Colebank, along the steep western slope of the Briery Mountain anticline. No commercial mines on this bed occur therein, but it has been opened by farmers along its crop at several points for local domestic

fuel. Westward from this line where the vein lies at varying distances below drainage, seven coal test borings have been drilled within the district, and three just off the southern border in the edge of Barbour county (See table, pages 220-221). The Survey was unable to obtain the logs of Nos. 93, 96 and 98, but the detailed records of the other seven are given on preceding pages of this chapter, and of the latter, Nos. 89, 92 and 95 did not penetrate deep enough to test the Lower Kittanning coal. Nos. 91 and 97A show its presence in minable dimensions, while Nos. 88 and 94 show it very much reduced and not of workable thickness and purity, but throughout the western portion of Reno, from all the information obtained, it is believed that this bed is more regular than in the northern districts of the county. Several sections at country banks and other exposures will now be given.

Reger obtained the following section, on the authority of J. W. Cool, at the **Thos. Cool Heirs mine**, located on the waters of Frog run, 0.6 mile northeast of Nazareth Church:

		Ft.	In.
Sandstone			
Draw slate		0	4
Coal, good.....2'	6"		
Shale, gray	0	6	
Bone	2	0	Middle
Gray shale, hard.....0	5		and
Coal, good	2	6	Lower
Bone	0	10	Kittanning
Coal, good	4	6	Coals
Slate, black	1	6	
Coal, good	2	6	17 3
Slate, black.....			
Shale, gray			

Elevation of coal, 2335' A. T. aneroid measurement.

According to Reger, the above opening had been abandoned so that it was not possible to get a section by direct measurement. If the above figures are correct, it is very probable that the Middle Kittanning vein is represented in the upper portion, since the latter closely overlies the Lower Kittanning coal at the Newburg shaft mine.

The following section was measured by Hennen at a well known country bank in this coal, located on the western slope of Laurel Ridge, just east of the road fork, 1 mile S. 30° W. of Nazareth Church:

Wolf Mine.—Lower Kittanning Coal.

		Ft.	In.
Sandstone, massive		50	0
Slate		3	0
Coal	1' 8"		
Coal, soft	3 11		
Coal, bony	1 1		
Coal, soft	2 10	9	6
Slate			

Elevation of coal, 2010' A. T., aneroid measurement.

The coal at the above opening has been mistaken for the Upper Freeport vein by several coal experts investigating this region. The following extracts are taken from portions of reports made to Hon. J. M. Guffey by Mr. Thomas Lynch, of Pittsburgh, Pa., and J. P. K. Miller, of Scottdale, Pa., relating to the above mentioned Wolf mine, the report being kindly furnished the Survey by Mr. Guffey:

"I had a lot of coal mined from the 'Wolf' opening and kept the sections above and below the bone separate, designating them 'top' and 'bottom'; hauled it in wagons to Thornton Station on the B. & O. R. R. loaded it into car C. L. & W. No. 8322, and shipped it to Valley Works of H. C. Frick Coke Company where the coal from each section was tested for coke, separately, and the coal from both sections, mixed, also tested for coke. In each case, we got good, hard, metallurgical coke, and when it was put on the yard at Valley Works, the men at that plant were unable to pick it out from the coke made at the same plant, from strictly Connellsville coal.

"I do not think the coke is the equal of standard Connellsville, in quality, but I do think it is equal, chemically, and superior, physically, to the average Klondike or Lower Connellsville, and is also superior, physically, to the Pocahontas coke, but not as good, chemically.

"The test proved, beyond doubt, that the seam of coal shown in the opening from which sample was taken will make good, metallurgical coke, without treatment of any kind, other than separating and picking out the bone.

"I selected out for analysis what I considered fair samples of coke from each of these three tests made at Valley Works; balance of the coke was shipped in H. C. F. C. Co. car No. 1500, to Messrs. Mackintosh, Hemphill & Company, Pittsburgh, Pa., for practical test in their cupola. We did not have enough coke to make a test in blast furnace. We had analyses made of each section of the coal, separately, and of both, mixed; also, analyses of the coke from these three tests.

"From investigations made and analyses of samples of both coal and coke taken from operations nearest the Guffey property, I am of the opinion that this seam of coal in the northern and western sections of the Guffey Field will have to be treated so as to reduce the sulphur and ash, in order to make a first-class metallurgical coke."

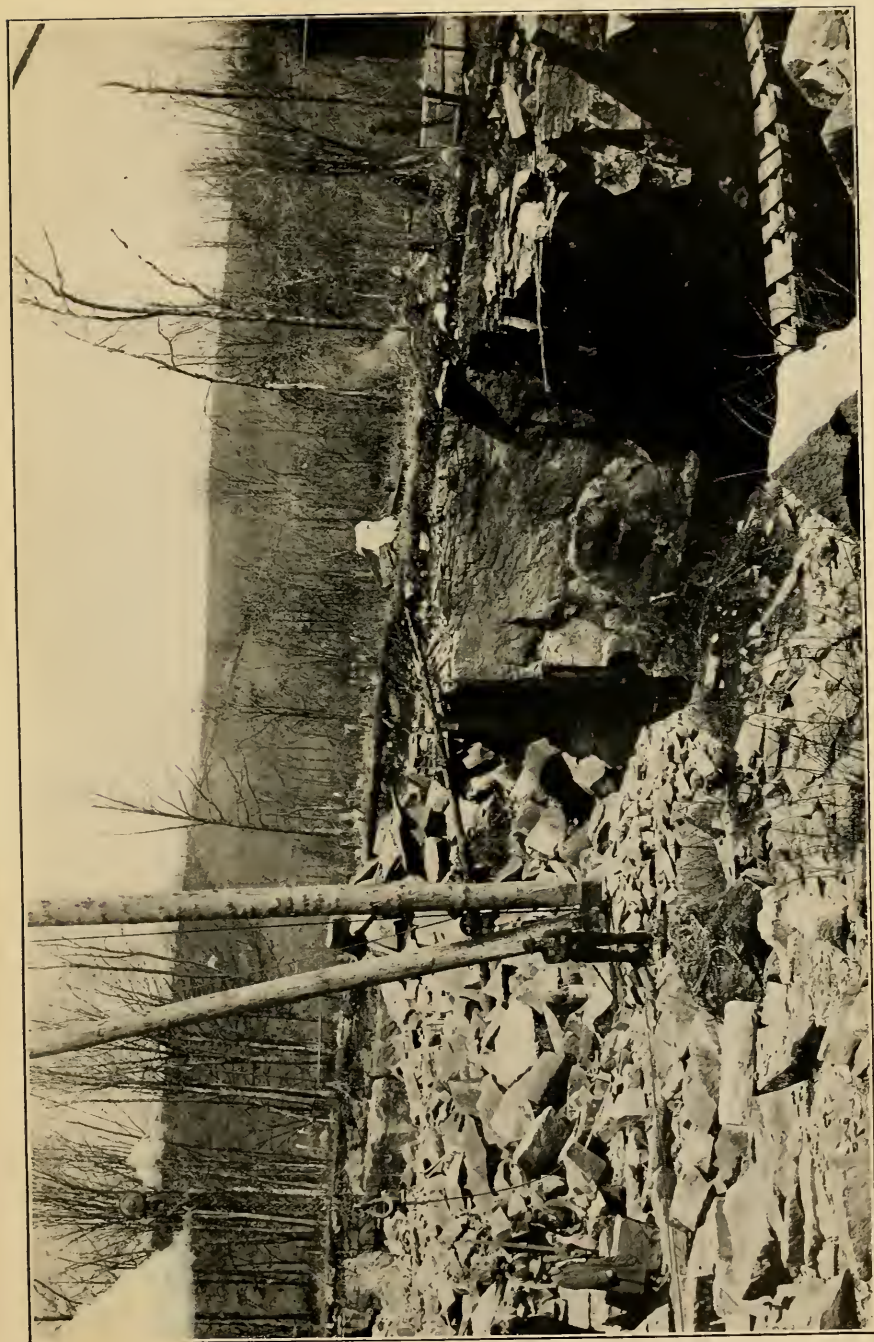


Photo by E. E. Knight
PLATE XXXII.—Quarry in the Saltsburg Sandstone Series near Kingwood, operated by the Kingwood Quarries Co.

Coking Test of Upper Freeport* (Lower Kittanning) Coal from Wolf Mine, Preston County, W. Va.
Test Made at Valley Mine, August, 1905.

No. of Oven.	No. lbs. coal charged.	Lbs. coke drawn.	No. lbs. Ashes.	Time in hours.	Analysis of Coal					Analysis of Coke.					Remarks.
					V. M.	F. C.	Ash.	Sul.	Phos.	V. M.	F. C.	Ash.	Sul.	Phos.	
105	10,000	6650	370	48	30.55	61.17	8.28	.979	.028	2.02	83.89	14.09	.868	.024	Bottom Section. Top
117	10,000	6900	320	48	27.97	64.85	7.18	.905	.022	1.32	85.03	13.65	.913	.025	Section. Top and Bottom.
108	10,000	6460	420	48	28.96	63.63	7.41	.990	.030	1.69	83.78	14.53	1.182	.025	Top and Bottom.
110	10,000	6840	440	48	28.62	64.16	7.22	.951	.025	1.20	85.65	13.15	.963	.024	Top and Bottom.
105	10,000	6700	320	48	29.27	63.20	7.53	.934	.025	1.20	86.63	12.17	.967	.024	Top and Bottom.
Av'g		6710	374		29.07	63.40	7.52	.951	.026	1.48	84.99	13.52	.978	.0244	

NOTE.—Good coke, very similar to Valley in cell-structure and fracture.

*Lower Kittanning coal and not the Upper Freeport.—R. V. H. and D. B. R.

"Scottdale, Pa., August 8th, 1905.

"Mr. Thomas Lynch, President,
Pittsburgh, Pa.

"Dear Sir:—Referring to your message of 7th instant: we are shipping to-day, from Valley Works, consigned to Mackintosh, Hemphill & Co., Pittsburgh, Pa., via P. R. R., H. C. F. Box Car 1500, containing coke made from the coal* received in C. L. & W. Car 8322.

"The car has been divided into three compartments. No. 1 containing three ovens of top and bottom, mixed, is loaded in one end; No. 2, one oven of top, is loaded in the other end; and No. 3, one oven of bottom, is loaded in middle of car.

"A card giving the above information has been tacked at each end of the compartment. Superintendent Lynch has retained separate samples of the coke in each compartment.

"We have wired Mr. Spencer the initial and number of the car.

"Very truly yours,
(Signed) "W. H. CLINGERMAN,
HVG.

"General Superintendent."

*Coal from the Wolf Mine.—R. V. H. and D. B. R.

"MACKINTOSH, HEMPHILL & CO.

"Fort Pitt Foundry.

"Pittsburgh, Pa., Sept. 29th, 1905.

"Dear Sir:—I enclose you report of tests on the trial car of coke which you sent us.

(Signed) "Yours truly,
"H. E. FIELD,
"Metallurgical Engineer."

TEST.

"Car H. C. F. No. 1500.

"Top and Bottom Mix"		Marked No. 1
Moisture		0.47
Ash		12.37
Volatile Matter		2.00
Fixed Carbon		84.42
Sulphur		.742

"This coke proved to be of excellent quality; iron came quick and hot and stood burden of a long heat very well. Test was made in cupola lined to 54", and gave nine (9) tons of hot iron per hour for a thirty (30) ton heat. This is about our average in this cupola under favorable conditions and when using first quality coke.

"Top"		Marked No. 2.
Moisture		0.62
Ash		10.17
Volatile Matter		2.53
Fixed Carbon.....		86.91
Sulphur		.707

"This coke gave very satisfactory results; iron came quick and hot. On account of small amount of coke in this division, a thorough test of its burden-bearing properties, amount melted per hour, in long heats, etc., could not be determined. The rate of melting, as long as the coke lasted, was approximately nine (9) tons of hot iron per hour.

"Bottom"	Marked No. 3
Moisture	0.22
Ash	11.69
Volatile Matter	2.40
Fixed Carbon	84.97
Sulphur	.72

"The coke in this division of the car did not give results as satisfactory as the other two. The iron came slow and not so hot. I would not want to make a positive statement that this was due wholly to the coke, on account of the small amount in this division; hence we could only estimate its quality from one trial, and then only in the first of the heat. From its analysis, I should judge it to be a very fair coke, and, in this instance, some other conditions may have interfered and prevented a fair test. The rate of melting, as long as the coke lasted was about seven and one-half (7½) tons of iron per hour; the iron was not very hot.

"With the exception of Division No. 1, the results obtained can only be considered in the light of estimates, on account of the small amount of coke in Divisions Nos. 2 and 3 which we had for the test.

(Signed)

"H. E. FIELD,

"Metallurgical Engineer."

The foregoing tests of the Lower Kittanning coal from the Wolf mine and coke manufactured therefrom speak for themselves, as they were made under the direction of men of established reputation in their field of endeavor; hence, they cannot but lend value to this report, since the tests are on a much greater scale than the State undertakes.

The following section was measured by Hennen at the **Bonnefield & Orr mine**, located 0.8 mile southwestward from the Wolf bank on the north edge of the private road:

	Ft.	In.
Sandstone, massive, buff, medium grained, micaceous	20	0
Coal 1' 8" Lower Kittanning Coal		
Coal, bony 0 9		
Coal, soft 2 8	5	1
Slate		
Elevation of coal, 1745' A. T., aneroid measurement.		

Southwestward along the western slope of Laurel Ridge, Reger collected samples for analysis and measured the following sections at three country banks in the Lower Kittanning vein:

Jonathan Funk Mine.—No. 71 on Map II.

Reno district, 2.1 miles northeast of Sinclair; Lower Kittanning Coal.

		Ft.	In.
1.	Sandstone, massive	5	0
2.	Coal, soft 1' 11"		
3.	Coal, bony 0 10		
4.	Coal, soft 2 0		
5.	Slate, black 0 1		
6.	Coal, good 0 7	5	5
7.	Shale		

Elevation of coal, 2170' A. T., aneroid measurement.

The composition of the sample, from only Nos. 2, 4 and 6 of above section, as reported by Messrs. Hite and Krak, is given under **No. 71** in the table of analyses at the end of this chapter.

S. M. Jones Mine.—No. 72 on Map II.

Reno district, 1.3 miles southeast of Sinclair; Lower Kittanning Coal.

		Ft.	In.
1.	Sandstone, flaggy	10	0
2.	Concealed	15	0
3.	Slate, black	0	6
4.	Coal, bony 0' 8 "		
5.	Coal, soft 0 3		
6.	Slate, black 0 0¼		
7.	Coal, soft 0 6		
8.	Slate, black 0 4		
9.	Coal, soft 3 3	5	0¼
10.	Shale, gray		

Elevation of coal, 2170' A. T., aneroid measurement.

For composition of sample from Nos. 5, 7 and 9 only, as reported by Messrs. Hite and Krak, see **No. 72** in table of analyses at the end of this chapter.

S. M. Jones Mine.—No. 73 on Map II.

Reno district, ¾ mile southeast of Sinclair; Lower Kittanning Coal.

		Ft.	In.
1.	Sandstone, flaggy	20	0
2.	Concealed	10	0
3.	Shale, gray	2	0
4.	Coal, soft 1' 6"		
5.	Shale, gray 0 9		
6.	Coal, soft 1 8		
7.	Shale, gray 1 5		
8.	Coal, soft 3 7	8	11
9.	Shale, gray		

Elevation of coal, 1660' A. T., aneroid measurement.

For composition of sample from No. 8 only of above section, as reported by Messrs. Hite and Krak, see **No. 73** in table of analyses at the end of this chapter.

Kingwood District.

An examination of Map II and Figure 8 shows the Lower Kittanning coal covering the entire area of Kingwood district, except a very small portion one-half mile eastward from Manown station; another, in the northern part along the Cheat river gorge; and a third in the southeastern part along the gorge of the same river. The only place it has been mined even at country banks in either of the three last mentioned localities was at the **James A. Brown mine**, located $\frac{1}{2}$ mile westward from Manown station, at an elevation of 2045' A. T., aneroid measurement. This digging had fallen shut when visited by Hennen in 1912, but according to James A. Freeland, who made the opening, the bed attained a thickness of 4 feet of clean coal on being driven into the hill a distance of 40 feet.

In the other portions of the district where the Lower Kittanning lies at varying distances below drainage, 15 coal test borings have been drilled (See table, pages 220-221). The Survey was unable to obtain the logs of five, but the detailed records of the others are given on preceding pages of this chapter, from which it will be observed that none penetrated deep enough to test the Lower Kittanning. No. 74B, located 2 miles northwest of Kingwood, the record of which is given on page 246, stopped probably not over 5 to 10 feet above this bed. Hence, it follows that the facts are very meager on which to form an opinion of its persistence and regularity in Kingwood district. However, it is believed by the authors that it maintains its reputation for irregularity that it bears in other portions of Preston county, and for the purposes of forming an estimate of available coal from this vein that an assumed thickness of 2 feet spread out over the entire area of the Lower Kittanning, as indicated on Map II and Figure 8, is conservative.

Portland District.

Portland catches two small areas of the Lower Kittanning coal as shown on Map II and Figure 8. The larger, lying along the northwest edge of the district in the Kingwood Basin, is made up of several smaller disconnected tracts; and the other in the southeastern corner in the Mount Carmel Basin. In the former region, six coal test borings (See table, pages 220-221) have been drilled, but the Survey was able to obtain the logs of only Nos. 82 and 83, both of which start below the Lower Kittanning coal, as will readily be seen in the Manheim section, page 94. In the Corinth region, only one (No. 84) coal test boring has been drilled, the detailed log of which, published on page 258, shows this bed 7 feet thick at a depth of 134 feet. Taking up first the Kingwood Basin area where only country banks occur, some sections will now be given as also other data.

In the northwestern corner of Portland, a sample for analysis was collected and the following data obtained by Reger at an opening in this bed, located near the summit of the east hillside of Roaring creek, $1\frac{1}{4}$ miles southeast of Hayden:

A. C. Lull Mine.—No. 76 on Map II.

			Ft.	In.
1.	Slate, black			
2.	Coal, soft 3'	1"		
3.	Slate, black 0	2		
4.	Coal, soft 0	10	4	1
5.	Shale			
	Elevation of coal, 2180' A. T., aneroid measurement.			

The composition of the sample from only Nos. 2 and 4 of above section, as reported by Messrs. Hite and Krak, is given under **No. 76** in the table of analyses at the end of this chapter.

Southwestward to the head of Joe run, a sample for analysis was collected and the following section measured by Reger at another opening in this bed, 1 mile southeast of Whetsell:

H. C. Beatty Mine.—No. 75 on Map II.

		Ft.	In.
1. Slate, black			
2. Coal, soft	0' 4"		
3. Slate, black	0	1	
4. Coal, soft	1	1	
5. Coal, hard and bony, with streaks of slate	0	7	
6. Coal, soft	2	2	4 3
7. Shale, gray			
Elevation of coal, 1920' A. T., aneroid measurement.			

For composition of sample from only Nos. 4 and 6 of above section, as reported by Messrs. Hite and Krak, see No. 75 in table of analyses at the end of this chapter.

Two and a half miles southwestward and three-fourths mile south of Morlan station, Reger measured the following section at a country bank:

J. F. Stoer Mine.—No. 74 on Map II.

		Ft.	In.
1. Shale, dark, with streaks of coal.....		10	0
2. Coal, soft	0' 2 "		
3. Shale, dark	0	3	
4. Coal, soft	0 1½	Lower	
5. Slate, black.....	0 0½	Kittanning	
6. Coal, soft	0 1½	Coal	
7. Slate, black, with coal streaks	0 4½		
8. Coal, soft, columnar.....	1 8	2	9
9. Shale, gray			
Elevation of coal, 2005' A. T., aneroid measurement.			

Southeastward in the Corinth region of Portland district, the Lower Kittanning has long been mined on a commercial scale, the data represented by the following being from mines in this locality:

John Wills, Corinth Mine.—No. 77 on Map II.

Portland district, 0.6 mile S. 50° W. of Corinth; **Lower Kittanning Coal.**

		Ft.	In.
1. Sandstone, massive			
2. Slate, cannel	0' 2"		
3. Coal, soft, columnar....	2 6½		
4. Slate, black...0' 0¾"	} 0	3	
5. Coal			
6. Slate, black...0 1¼			
7. Coal, soft	0	8	

			Ft.	In.
8.	Binder, with streaks of coal	0" to 0' 0½"		
9.	Coal, soft.....	0	3	
10.	Shale, gray....	0' 10" to 2	0	
11.	Coal	1	0	
12.	Shale	0	2	
13.	Coal (reported)	1	0	7 11
14.	Shale			

Tidal elevation, 2550', aneroid; principal office, 703 Pennsylvania Bldg., Philadelphia, Pa.; capacity 100 tons; 7 laborers and 28 miners employed; coal shipped to Philadelphia for steam; none coked; butts, none; horse haulage; greatest rise, west; sample collected for analysis from 3, 5 and 9 of section, on pillar in 2nd Right Heading, by D. B. Reger.

For composition and fuel value, as reported by Messrs. Hite and Krak, see **No. 77** in table of analyses at end of this chapter.

A section was once measured and a sample for analysis collected at the above mine for the Survey by A. P. Brady, the results being published on pages 484 and 485 of Volume II of the State Geological Reports.

Nordeck Bros. Mine.—No. 78 on Map II.

Portland district, 3.9 miles S. 25° E. of Terra Alta; Lower Kittanning Coal.

			Ft.	In.
1.	Sandstone			
2.	Draw slate		0	2
3.	Coal, soft	2' 10"		
4.	Slate	0' 0½"		
5.	Coal	0 1	0	3
6.	Slate	0 1½		
7.	Coal, soft	1	0	
8.	Shale, gray	1	0	5 1
9.	Coal, reported about.....	3' 0"		

Tidal elevation, 2485', aneroid; 2 to 5 men employed; horse haulage; local use; greatest rise, N. W.; mine operated by John M. Hauger; sample collected from Nos. 3 and 7 of section by D. B. Reger.

For composition and fuel value of above coal, as reported by Messrs. Hite and Krak, see **No. 78** in table of analyses at the end of this chapter.

Samples for analysis were collected and the following sections measured by Hennen at two country banks in this coal in the same region:

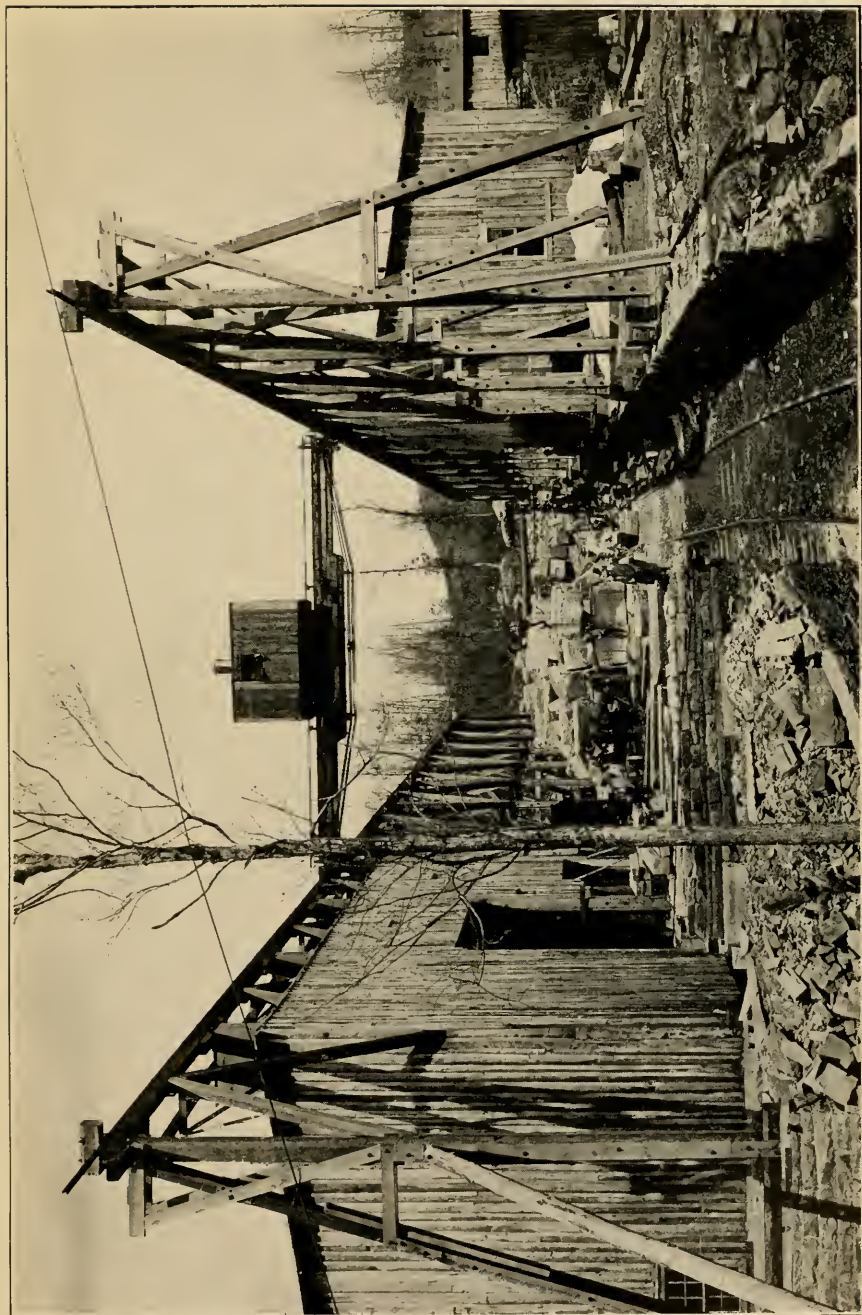


Photo by E. E. Knight
(See Text).

PLATE XXXIII.—Cutting Plant of the Kingwood Quarries Company near Kingwood.

Crane Heirs Mine.—No. 79 on Map II.

Portland district, 2 miles southwest of Corinth; **Lower Kittanning Coal.**

			Ft.	In.
1.	Slate, black, and sandy			
2.	Coal, soft	2' 8"		
3.	Slate, dark gray	0 1		
4.	Coal	0 1		
5.	Slate	0 2		
6.	Coal	0 11		
7.	Slate, gray	0 10		
8.	Coal	1 8	6	5
9.	Slate, pavement			
	Elevation of coal, 2460' A. T., aneroid measurement.			

Two samples were collected at the above mine; viz, one from only Nos. 2 and 6, represented by Lab. No. 774H(a), and the other from only No. 8 of section, represented by Lab. No. 774H(b), the composition of both of which, as reported by Messrs. Hite and Krak, is reported under **No. 79** in table of analyses at the end of this chapter.

William Ashler Mine.—No. 81 on Map II.

Located $\frac{1}{2}$ mile southwest of Crellin, Md.; **Lower Kittanning Coal.**

			Ft.	In.
1.	Slate			
2.	Coal, soft	7" to 0'	9	"
3.	Slate, black	4" to 0	7	
4.	Coal, soft	1 3		
5.	Slate, black	0 0½		
6.	Coal, bony	1 0	3	7½
7.	Fire clay (Lower Kittanning)		3	0
	Elevation of coal, 2390' A. T., aneroid measurement.			

Two samples were collected at the last mine; one from only Nos. 2 and 4, represented by Lab. No. 795H, and the other from only No. 6 of section, represented by Lab. No. 795H(a), the composition of both of which, as reported by Messrs. Hite and Krak, is given under **No. 81** in table of analyses at the end of this chapter.

The foregoing results on the Lower Kittanning coal in Portland district reveal a high grade coal, especially in the Mount Carmel Basin, where, owing to its low sulphur and ash content, it would no doubt be finely adapted for use in by-product ovens. It is believed that in the latter region this bed will maintain an average thickness of 5 feet.

Union District.

Union district catches two very small areas of the Lower Kittanning in its northeast and southeast corners as will be observed on Map II and Figure 8. Only one commercial mine occurs therein. In the Mount Carmel Basin this vein has been mined quite extensively by farmers for local domestic fuel. The Davis Coal and Coke Co. has drilled two coal test borings—Nos. 103 and 104—in and near the southeast corner of Union, the logs of which are published in detail on page 259. Both show this vein in fine development. In the same region the following section was measured by Hennen at an opening in this bed, located $\frac{1}{2}$ mile northward from Bore Hole No. 103 above mentioned:

			Ft.	In.
Slate				
Coal, soft	2'	0"		
Slate, gray, dark.....	0	2		
Coal	1	0		
			3	2

Concealed by water in mine.....

Elevation of coal, 3005' A. T., aneroid measurement.

Passing to the Mount Carmel Basin portion of the district, the following section was measured by Reger at an opening in this coal, located 0.7 mile northwest of Coal Prospect No. 80 on Map II:

			Ft.	In
Sandstone, flaggy.....				
Coal, slaty	0'	10 "		
Coal, soft	1	8		
Slate, dark	0	0½		
Coal, bony	0	1		
Slate, dark	0	0½		
Coal	0	8		
Slate, black	0	1		
Coal and concealed by water	1	0		
			4	6

Elevation of coal, 2495' A. T., aneroid measurement.

The following section was measured by Hennen at the **Leroy Guthrie mine**, located $3\frac{1}{2}$ miles south of Corinth in the edge of Garrett county, Maryland:

		Ft.	In.
Sandstone, massive			
Slate, black		0	3
Coal, bony	0' 10"		
Coal, soft	0	6	
Coaly slate	0	5	
Coal, soft	1	9	Lower
Slate, black	0	2	Kittanning
Coal, soft	0	9	Coal
Slate, gray	24" to 0	11	
Coal, bony.....	0	6	
Coal, good	1	8	7 6

Slate pavement

Elevation of coal, 2650' A. T., aneroid measurement.

The following data and a sample for analysis were collected at the only commercial mine in Union district:

Kendall Lumber Co., Arnold Run Mine.—No. 80 on Map II.

Union district, 4.5 miles N. 40° E. of Aurora; **Lower Kittanning Coal.**

		Ft.	In.
1. Slate, visible		2	0
2. Coal, soft	2' 7"		
3. Slate	0' 0½"		
4. Coal	0 1½	0	3
5. Slate	0 1		
6. Coal	0	10	
7. Shale, hard	0	11	
8. Coal, hard	0	8	
9. Shale, gray.....	0 1	5	4

10. Coal, thickness concealed.....

Tidal elevation, 2470', aneroid; principal office, Crellin, Md.; capacity, 50 tons; 5 laborers and 13 miners employed; horse haulage; part of coal used at Crellin, Md.; some used in Hutton tannery; some shipped east; butts, south; greatest rise, southeast; sample collected for analysis from Nos. 2 and 6 of section in Main Heading, by D. B. Reger; P. L. Mersing, superintendent, authority for data.

For analysis and fuel value of this coal, as reported by Messrs. Hite and Krak, see **No. 80** in table of analyses at the end of this chapter.

Quantity of Lower Kittanning Coal Available.

A careful study of the foregoing data on the Lower Kittanning in Preston by districts and the table of borings, pages

220-1, makes it apparently safe to assume an average thickness of **2 feet** spread out over the entire area of this coal, as indicated on Map II and Figure 8 in forming an estimate of the available tonnage. Figuring on this basis with a planimetric determination by Reger of the area on Map II, the following results are obtained:

District	Square Miles	Acres	Cubic Feet of Coal	Short Tons of Coal
Grant	74.38	47,605	4,197,347,600	167,893,904
Pleasant	60.80	38,910	3,389,839,200	135,593,568
Valley	53.53	34,260	2,984,731,200	119,389,248
Lyon	42.14	26,970	2,349,626,400	93,985,056
Kingwood	57.25	36,640	3,192,076,800	127,683,072
Portland	22.02	14,090	1,227,520,800	49,100,832
Reno	55.02	35,215	3,067,930,800	122,717,232
Union	1.29	825	71,874,000	2,874,960
Totals	366.43	234,515	20,480,946,800	819,237,872

The Clarion Coal.

The Clarion coal, briefly described on pages 115-6, has been mined at several points by farmers of Preston for local domestic fuel, but no commercial mines occur therein. The entire area covered by this vein is exhibited on Figure 9, but, as appears on subsequent pages, all this region is not minable. Its character at these country banks will now be discussed by districts.

Grant District.

An examination of Map II and Figure 9 shows the Clarion coal lying below drainage over almost the entire surface of Grant, its crop being confined to a small area along the north-west edge along the steep eastern slope of the Chestnut Ridge anticline; another, along the gorges of Cheat river and Sandy creek; and a third in the extreme southeast corner of the district near the crest of the Briery Mountain anticline. As mentioned under the discussion of the Lower Kittanning coal for Grant, the only source of information as to the thickness and regularity of this bed in the intermediate region where it lies at varying depths below drainage is the logs of coal test borings. Fifteen have been drilled therein, but, as mentioned heretofore, the Survey was able to obtain the logs of but four,

of which only No. 7 (See Brandonville section, page 80) gives any information concerning the Clarion coal. The record of this boring shows it split into two benches by several feet of sandy shale, both of which are slaty and impure.

The following section was obtained by Reger in the north-western corner of Grant district at the **Everly Brothers mine**, at the east edge of the private road, 1.5 miles northwest of Florence:

			Ft.	In.
1.	Shale, sandy			
2.	Coal, soft	2' 9"		
3.	Shale, gray.....	2 0		
4.	Shale, black and hard....	0 2	Clarion	
5.	Shale, gray.....	3 0	Coal.	
6.	Coal reported, concealed to base of old opening.	5 0	12	11

Elevation of coal, 2155' A. T., aneroid measurement.

The opening was driven on No. 6 of section, Nos. 1 to 5 being exposed in the hill immediately above.

In the extreme southern point of the district, a sample for analysis was collected and the following section in a modified form, as published on pages 598-599 of Volume II(a), was measured by Hennen at a country bank in this coal:

James Birtcher Mine.—No. 83 on Map II.

Grant district, 0.4 mile northwest of mouth of Big Sandy; **Clarion Coal.**

			Ft.	In.
1.	Shale, gray			
2.	Coal	1' 1 "		
3.	Slate	0 1½		
4.	Coal	2 9	3	11½

5. Fire clay
Elevation of coal, 1400' A. T., aneroid measurement.

The composition of the sample from only Nos. 2 and 4 of section, as reported by Messrs. Hite and Patton, is given under **No. 83** in the table of analyses at the end of this chapter.

The following section is reported by Reger at the crop of this coal along the west hillside of Big Sandy, 0.2 mile below the mouth of Laurel run:

	Ft.	In.
Shale, brown and sandy.....	4	0
Coal, good, Clarion.....	1	5
Shale, black and hard.....		

Elevation of coal, 1470' A. T., aneroid measurement.

The following section was measured by Hennen at the **John Nicola mine**, in the southeastern edge of Grant district, on the east side of the road, 0.3 mile northward from Hazelton :

	Ft.	In.
Slate, black	2	0
Sandstone	1	6
Slate, black	2	0
Coal, soft 1' 3"		
Slate, black 0 9		
Coal 0 2	Clarion Coal	2 2

Concealed by water.....

Elevation of coal, 1915' A. T., aneroid measurement.

Owing to water in the above abandoned digging, it was not possible to get a total section.

The foregoing data on the Clarion in Grant district show this coal to be even more irregular than the Lower Kittanning bed, a characteristic feature which it seems to maintain throughout its area in Preston county. It is quite evident that in all the regions where it lies below drainage a large number of test borings will have to be sunk to determine the continuity of this seam.

Pleasant District.

The Clarion coal lies at varying distances below drainage over the major portion of Pleasant district, as appears from an examination of Map II and Figure 9, its crop being confined to the deep gorges of Big Sandy creek and Cheat river on the west, and to an irregular line extending southwestward from Hazelton to an intersection with the Pleasant-Portland district line, 1 mile eastward from Lenox, on the east. In the intermediate region where it lies below drainage, 13 coal test borings have been drilled, a discussion of which is given on preceding pages and under the description of the Lower Kittanning coal for the same district. Even the logs of the borings the Survey was able to obtain show the tests did not penetrate deep enough to reach this vein. Hence, in this portion of the district, the information is very meager on which to form an opinion as to its thickness and continuity. It is the opinion of the authors, however, that it attains practically the same development as in Grant and should range in thickness from 18 inches to 4 feet.

Its thickness and character in the regions of its crop will now be discussed.

In the western edge of Pleasant district, a sample for analysis was collected and the following section measured by Hennen at a country bank, located on the east hillside of Big Sandy, 1.4 miles northwest of Rockville:

Silas Metheny Mine.—No. 84 on Map II.

			Ft.	In.
1.	Sandstone			
2.	Slate, black		0	6
3.	Coal, good, Clarion, upper bench.....		2	9
4.	Concealed		20	0
5.	Shale, yellow, and sandy		10	0
6.	Slate, cannelly.....1' 0"	} Clarion		
7.	Coal			
8.	Shale, dark gray.....1 2		2	4
9.	Coaly slate.....0 1	} Bench		
10.	Fire clay, good.....		1	3
11.	Sandstone and concealed.....		34	0
12.	Sandstone, great cliff, Homewood.....			

Elevation of upper bench, 1360' A. T., aneroid measurement.

The composition of the sample from No. 3 only of above section, as reported by Messrs. Hite and Krak, is given under **No. 84** in the table of analyses at the end of this chapter.

In the eastern edge of the field in Pleasant district, a sample for analysis was collected and the following section measured at an opening in this vein, located on the south edge of the public road, 1.9 miles eastward from the summit of Kelley Knob:

Charles Rhodheaver Mine.—No. 85 on Map II.

			Ft.	In.
1.	Fire clay		0	6
2.	Coal, soft	1' 5"		
3.	Slate, black, lenticular	0" to 0	3	Clarion Coal.
4.	Coal, soft, bright, columnar	1 5	3	1
5.	Slate pavement			

Elevation of coal, 2295' A. T., aneroid measurement.

The composition of the sample from only Nos. 2 and 4 of the above section, as reported by Messrs. Hite and Krak, is given under **No. 85** in the table of analyses at the end of this chapter.



PLATE XXXIV.—Quarry in Rowlesburg Sandstone at Rowlesburg, showing ripple marks and mud cracks on large boulder.
Photo by E. E. Knight

In the northeast corner of the same district on the crest of the Briery Mountain anticline, Hennen collected a sample for analysis and measured the following section at an opening in the Clarion coal, located on the southwest edge of Fairfield Hill:

Arthur Savage Mine.—No. 86 on Map II.

		Ft.	In.
1. Sandstone, massive			
2. Slate, gray		0	2
3. Coal, soft	0' 10"		
4. Coal, harder.....	1 2	Clarion	
5. Slate, black	0 1	Coal.	
6. Coal, medium hard.....	1 0	3	1
7. Slate			

Elevation of coal, 2325' A. T., aneroid measurement.

For composition of sample from Nos. 3, 4 and 6 of section, as reported by Messrs. Hite and Krak, see No. 86 in table of analyses at the end of this chapter.

Valley District.

A glance at Map II and Figure 9 shows that the major portion of Valley district is underlain with the Clarion coal, over the most of which it lies at varying depths below drainage, the crop being confined to near the crest of the Chestnut Ridge anticline on the west, and to the Cheat river gorge on the northeast. In the other portions of Valley, as mentioned under the description of the Lower Kittanning coal for the same district, a number of coal test borings have been drilled, and of the logs of these which the Survey was able to obtain, only No. 42, located 1 mile due south of Masontown, penetrated deep enough to test the Clarion coal, the latter reporting the same separated into two benches by 6' 5" of fire clay.

In the southern edge of Valley district, the logs of the Merchants Coal Co. borings—Nos. 55 to 60—would probably throw some light on the thickness and continuity of the Clarion, but, as mentioned on a preceding page, the Survey was unable to obtain the records of these tests.

In the northern point of the district, this coal has been mined quite extensively along its crop by farmers for local domestic fuel. The seam was once sampled in this region by

Hennen and the results, as published on page 362 of the Monongalia-Marion-Taylor Report of the State Survey, in a modified form, are as follows:

Zacheus Gibson Mine.—No. 82 on Map II.

Located on Bee run, 1.5 miles S. E. of Beaverhole.

			Ft.	In.
1.	Sandstone, massive			
2.	Coal	2' 6"		
3.	Slate, black..... $\frac{1}{2}$ " to 0	1	Clarion	
4.	Coal	1	0	Coal.
5.	Slate, gray.....	0	8	
6.	Coal	2	4	6 7
7.	Fire clay and concealed.....		10	0
8.	Sandstone, massive, Homewood.....			
	Elevation of coal 1525' A. T., aneroid measurement.			

The composition and fuel value of the sample from Nos. 2, 4 and 6 of the above section, as reported by Messrs. Hite and Krak, are given under **No. 82** in the table of analyses at the end of this chapter.

Lyon District.

The Clarion coal lies below drainage over almost the entire area of Lyon, except two or three small patches along the northwestern edge of the district where it has been brought to the surface on the steep eastern slope of the Chestnut Ridge anticline. No exposures of the bed were observed in this locality, but its thickness and character may be observed in the immediately adjoining region of Monongalia and Taylor counties at two different mines, one of which is located on Laurel run, 2.1 miles southwest of Gladesville, and the other, on a branch of Laurel run, Taylor county, 1.2 miles northwest of Irondale, all of which is published on pages 362-363 of the Monongalia-Marion-Taylor Report of the State Survey.

In that portion of the district lying to the eastward of its crop, ten coal test borings (See table, pages 220-221) have been drilled, the detailed records of seven of which are given on preceding pages of this chapter. Of the latter, only Nos. 63, 68 and 72 penetrated deep enough to test the Clarion coal. Nos. 63 and 72 report it present in fair thickness, but much split up with slate, while No. 68 reveals its absence from the

measures. Hence, it is quite evident that considerable core drilling will have to be done to determine the extent of this vein in Lyon district.

Reno District.

An examination of Map II and Figure 9 shows the Clarion coal area confined to the western half of Reno, and its crop therein to an irregular line extending southwestward from near Anderson to an intersection with the Preston-Barbour county line, slightly over a mile southeast of Colebank. Along this line of crop only one exposure was noted, and at this place the following section was made by Reger at the **George Sanders opening**, located a short distance south of the road fork on the west side of Buckhorn run, 1.5 miles west of Manheim:

	Ft.	In.
Sandstone, massive, Clarion.....	25	0
Coal and shale, Clarion.....	2	0
Concealed by water (could not get total section)		
Elevation of coal, 2275' A. T., aneroid measurement.		

Westward from this crop line where the Clarion coal lies at varying distances below drainage, seven coal test borings have been sunk within the district, and three just off the southern border in the edge of Barbour county (See table, pages 220-221). But, as mentioned under the description of the Lower Kittanning coal for the same area, the logs of the borings from which the Survey was able to obtain records show that only one test—No. 94, located 1 mile northwest of Colebank in the edge of Barbour—penetrated deep enough to determine the Clarion, and it reports only 2 inches of coal at this horizon. Although the foregoing data are very meager on which to base an opinion, it is believed by the authors that the chances of developing any large area of this bed in Reno in minable thickness and purity are quite doubtful.

Kingwood District.

The horizon of the Clarion coal underlies almost the entire area of Kingwood district at varying depths below drain-

age, its crop being confined, as can readily be observed on Map II, to a small area in the northern portion along the deep gorge of Cheat river, and another along the west hillside of the same stream in the southeastern corner of the district. No exposures were observed therein.

As mentioned under the discussion of the Lower Kittanning coal for the same area, the Survey was able to obtain the logs of only ten of the fifteen coal test borings sunk in the intermediate portion of the district (See table, pages 220-221), the records of the same being given on preceding pages, from which it will be observed that none penetrated deep enough to test the Clarion coal. However, it is very probable that this vein maintains its reputation for irregularity, and several tests would have to be drilled to determine its continuity over any great area.

Portland District.

Portland district catches two small areas of the Clarion coal, as will readily be seen from an examination of Map II and Figure 9, one along the northwest border in the Kingwood Basin, and the other in the southeast corner in the Mount Carmel Basin. In the former region, the Survey was able to obtain the logs of only two of the six coal test borings drilled therein, neither of which gives any information concerning this coal. (See Manheim section, page 94). In the Corinth region only one coal test boring—No. 84—has been drilled, the log of which, published on page 258, shows 3 feet of Clarion coal, 60 feet below the Lower Kittanning vein.

In the northwestern edge of Portland district, the following section was measured by Hennen at the **Thornton Hardesty mine**, located 1 mile southeast of Lenox:

		Ft.	In.
Sandstone, massive, grayish white, Clarion.....		20	0
Coal, soft	1' 6 "		
Shale, gray	0 4		
Coal, soft	0 11	Clarion	
Shale, gray	0 0½	Coal.	
Coal, slaty	0 7		3 4½

Slate pavement

Elevation of coal, 2090' A. T., aneroid measurement.

Passing to the southeastern corner of the same district, the following section was measured by Hennen at the crop of this coal in the railroad cut, 0.2 mile north of Corinth:

			Ft.	In.
Concealed and shale				
Coal, soft	0'	11"		
Slate, black	0	1	Clarion	
Coal, soft	1	2	Coal.	
Coal, slaty and cannelly.....	1	8		3 10
Slate				
Elevation of coal, 2450' A. T., aneroid measurement.				

It is problematical whether or not this vein should be classed as minable in Portland district, owing to its slaty character. It will be several years before an operation in the same could be run with profit, and only when the purer and thicker veins approach exhaustion.

Union District.

An examination of Map II and Figure 9 shows the Clarion coal in two very small areas in Union, one in the northeastern corner in the Mount Carmel Basin, and the other in the extreme southern point of the district. No exposures of this vein were observed in either region. Neither of the borings—Nos. 103 and 104—in the southern point penetrated deep enough to test this coal. There is a probability of its attaining about the same development in Union as in the Corinth region of Portland district, or a thickness of about 3 feet.

Quantity of Clarion Coal Available.

An examination of Figures 8 and 9 shows that the Clarion coal has a slightly greater areal extent than the Lower Kittanning vein, but a careful study of all the information obtained on both beds warrants the belief that it will not average more than half the thickness of the latter seam. Figuring on this basis, the total available Clarion coal for Preston county is approximately 500,000,000 short tons.

MINABLE COALS OF THE POTTSVILLE SERIES.

The Quakertown Coal

The Quakertown appears to be the only minable coal in the Pottsville series of Preston county. Its crop should follow closely the line dividing these measures from the Mauch Chunk series next below as outlined on Map II. The approximate minable area of the bed is indicated on Figure 10, which shows the same confined to three separate tracts along the eastern boundary of Preston. In these localities its thickness, character and composition have already been discussed in Chapter VIII, pages 181-182.

An examination of Map II will readily show that the Quakertown coal covers a much greater portion of the county than the **approximate minable area** indicated on Figure 10, the latter being apparently the only region in which it much exceeds one foot in thickness. Hence, in forming an estimate of available coal for this vein, the other portions of Preston have been ignored. A planimetric determination of the area of this seam as outlined on Figure 10 gives 27 square miles—17,280 acres. The data in Chapter VIII show the coal in this region ranging in thickness from 20 to 33 inches, so that the assumption of an average thickness of 1 foot spread out over the latter area, in arriving at the **available tonnage**, appears conservative. Figuring on this basis, 30,000,000 short tons is obtained.

ABSENCE OF COAL IN THE MISSISSIPPIAN AND DEVONIAN ROCKS.

As mentioned in Chapters IX and X under the description of these beds, there is almost a complete absence of coal in any form in the Mississippian and Devonian measures of Preston county, although faint traces along with thin beds of impure fire clay were observed at two or three different points in the Chemung series along the main line of the Baltimore & Ohio railroad between Rowlesburg and Terra Alta.



Figure 10—Showing the apparent minable area only of the Quaker-town Coal (See description in text).

Summary of Available Coal.

	Short Tons
Pittsburgh Coal.....	3,500,000
Elk Lick Coal.....	67,000,000
Harlem Coal.....	47,250,000
Bakerstown Coal.....	189,055,552
Upper Freeport Coal.....	770,000,000
Lower Freeport Coal.....	223,000,000
Upper Kittanning Coal.....	543,289,032
Lower Kittanning Coal.....	819,237,872
Clarion Coal	500,000,000
Quakertown Coal.....	30,000,000
Grand total.....	3,190,332,456

The above summary is an estimate of the amount of coal remaining in the ground. It does not follow that all the above will eventually be mined; in fact, the percentage of recovery of coal beds in West Virginia varies from 45 to 95. In forming an estimate of what may be mined, the average of these figures, or 70 per cent., appears to be within safe limits. On this basis the amount of coal that may be recovered would be 2,233,000,000 short tons.

MINABLE COAL BY MAGISTERIAL DISTRICTS.

In addition to the foregoing discussion of the minable coals by series, it was deemed advisable to give a brief summary of the data by magisterial districts and page references thereon, in order to facilitate investigation by the reader of the coal resources of any particular portion of the county.

The following tables for each magisterial district of Preston give not only the names of the apparent minable coals therein, but also page references to all available data on the thickness, character, composition, fuel value and distribution of each vein. The names in black font type indicate that the detailed crop of the coal is outlined on Map II:

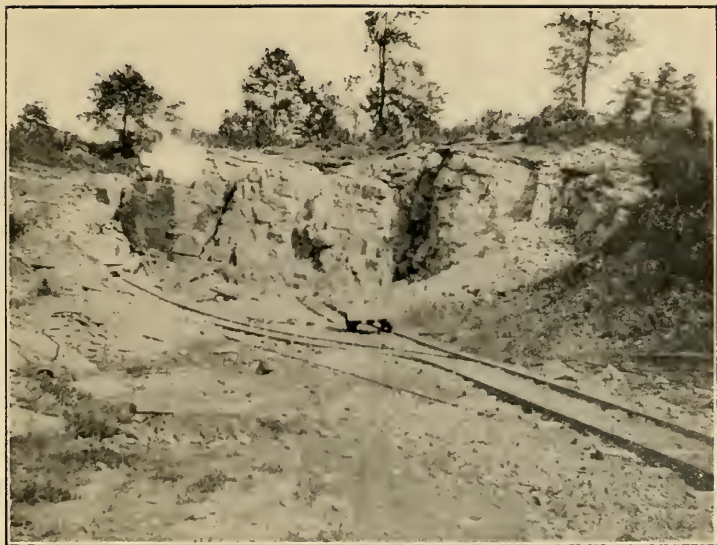


PLATE XXXV(a).—Quarry of the Terra Alta Lime Co. in the Greenbrier Limestone, 2 miles northeast of Terra Alta. (See Text).



PLATE XXXV(b).—Quarry in Clarion Sandstone near Irondale, operated by the Warfield Sand & Stone Co. for glass sand. (See Text).

Grant District.

Name of Coal.	Pages of this Report.
Bakerstown (See Fig. 5, page 267).....	58, 114, 133, 266-8, 364.
Upper Freeport (See Fig. 6, page 270).....	58, 77, 82, 152-4, 156, 198, 200, 220, 269-277, 311, 364-6.
Lower Freeport.....	58, 80, 82, 152, 159, 160-3, 166, 168, 312, 366.
Upper Kittanning (See Fig. 7, page 313)...	58, 80, 152, 170, 220, 314, 315, 324, 366.
Lower Kittanning (See Fig. 8, page 326)...	58, 77, 80, 82, 152, 173-4, 220, 324-8, 348, 366-7.
Clarion (See Fig. 9, page 350).....	58, 77, 81, 152, 175-6, 220, 348-351, 357, 367.

Pleasant District.

Name of Coal.	Pages of this Report.
Bakerstown (See Fig. 5, page 267).....	58, 82, 114, 133-4, 226-7, 266-8, 364.
Upper Freeport (See Fig. 6, page 270).....	58, 84, 152-4, 156-7, 198, 200, 220, 224-8, 277-283, 311, 364-6.
Lower Freeport.....	58, 84-5, 152, 157, 159, 163-5, 205, 312, 366.
Upper Kittanning (See Fig. 7, page 313)...	58, 83-5, 152, 170, 220, 315-7, 324, 366.
Lower Kittanning (See Fig. 8, page 326)...	58, 83-4, 152, 173-4, 204, 220, 328-9, 348, 366-7.
Clarion (See Fig. 9, page 350).....	58, 83, 85-6, 152, 175-6, 220, 351-3, 357, 367.
Quakertown (See Fig. 10, page 359).....	58, 84, 177, 181, 204, 358, 367.

Valley District.

Name of Coal.	Pages of this Report.
Harlem	58, 114, 128-9, 266, 364.
Bakerstown (See Fig. 5, page 267).....	58, 114, 133-5, 229, 238, 266-8, 364.
Upper Freeport (See Fig. 6, page 270).....	58, 87, 115, 152-4, 198, 200, 220-1, 229, 231-239, 283-292, 311, 364-6.
Lower Freeport.....	58, 86, 88, 152, 159, 165, 229, 233, 312, 366.
Upper Kittanning (See Fig. 8, page 313)...	58, 88, 152, 170, 220-1, 230, 235, 317-8, 324, 366.
Lower Kittanning (See Fig. 8, page 326)...	58, 152, 173, 174, 220-1, 233, 236, 329-331, 348, 366-7.
Clarion (See Fig. 9, page 350).....	58, 86, 152, 175-6, 233, 236, 353, 354, 357, 367.

Lyon District.

Name of Coal.	Pages of this Report.
Elk Lick.....	58, 90, 113, 120-1, 265-6, 364.
Harlem	58, 89, 90, 114, 128-9, 266, 364.
Bakerstown (See Fig. 5, page 267).....	58, 90, 114, 133, 136, 266-8, 364.
Upper Freeport (See Fig. 6, page 270).....	58, 88, 90, 115, 152-4, 198, 200, 221, 240, 242, 244, 292-8, 311, 364-6.
Lower Freeport.....	58, 91, 152, 159, 240, 312, 366.
Upper Kittanning (See Fig. 7, page 313)...	58, 152, 170, 221, 241, 242-3, 318-20, 324, 366.
Lower Kittanning (See Fig. 8, page 326)...	58, 91, 152, 173-4, 221, 241, 243-4, 331-4, 348, 366-7.
Clarion (See Fig. 9, page 350).....	58, 152, 175-6, 221, 241, 244, 354-5, 357, 367.

Reno District.

Name of Coal.	Pages of this Report.
Elk Lick.....	58, 113, 116-7, 120-2, 265-6, 364.
Harlem	58, 114, 116-7, 128, 131, 257, 266, 364.
Bakerstown (See Fig. 5, page 267).....	58, 114, 116, 133, 138-9, 257, 266-8, 364.
Upper Freeport (See Fig. 6, page 270).....	58, 97, 152-4, 198, 200, 221, 251-3, 255-7, 304-7, 311, 364-6.
Upper Kittanning (See Fig. 7, page 313)...	58, 97, 152, 170, 221, 320, 324, 366.
Lower Kittanning (See Fig. 8, page 326)...	58, 152, 173-4, 221, 252, 256, 258, 334-341, 348, 366-7.

Kingwood District.

Name of Coal.	Pages of this Report.
Elk Lick.....	58, 113, 120, 122-3, 265-6, 364.
Harlem	58, 92-3, 114, 128-130, 266, 364.
Bakerstown (See Fig. 5, page 267).....	58, 93, 114, 133, 136-7, 266-8, 364.
Upper Freeport (See Fig. 6, page 270).....	58, 152-4, 198, 200, 221, 245-250, 298-304, 311, 364-6.
Lower Freeport.....	58, 152-3, 159, 165, 312, 366.
Upper Kittanning (See Fig. 7, page 313)...	58, 94, 152, 170, 221, 247, 321-2, 324, 366.
Lower Kittanning (See Fig. 8, page 326)...	58, 152, 173-4, 221, 341, 348, 366-7.
Clarion (See Fig. 9, page 350).....	58, 152, 175-6, 221, 355-7, 367.

Portland District.

Name of Coal.	Pages of this Report.
Harlem	58, 114, 128, 130, 266, 364.
Bakerstown (See Fig. 5, page 267)	58, 114, 133, 266-8, 364.
Upper Freeport (See Fig. 6, page 270)	58, 152-4, 157, 198, 200, 221, 307-9, 311, 364-6.
Lower Freeport	58, 152, 157, 159, 163, 212, 312, 366.
Upper Kittanning (See Fig. 7, page 313)	58, 152, 170, 221, 322-4, 366.
Lower Kittanning (See Fig. 8, page 326)	58, 152, 173-4, 221, 258, 342-5, 348, 366-7.
Clarion (See Fig. 9, page 350)	58, 95, 152, 175-6, 212, 221, 258, 356-7, 367.
Quakertown (See Fig. 10, page 359)	58, 95, 152, 177, 181-2, 212, 358, 367.

Union District.

Name of Coal.	Pages of this Report.
Lower Kittanning (See Fig. 8, page 326)	58, 152, 173, 174, 221, 259, 260, 346-8, 366-7.
Clarion (See Fig. 9, page 350)	58, 152, 175-6, 221, 357, 367.
Quakertown (See Fig. 10, page 359)	58, 152, 177, 181, 358, 367.

TABLE OF COAL ANALYSES.

The following table, containing the chemical analyses, calorific determinations and fuel ratio of 89 mines and prospects sampled in Preston county, is the exclusive work of members of the Survey staff. The chemical and calorimetric work is mostly by J. B. Krak, Assistant Chemist, under the supervision and with the assistance of B. H. Hite, Chief Chemist. The numbers at the left hand margin correspond to the numbers given with the mine section in the text and on Map II. For additional explanations, see page 219 at the beginning of this chapter, and page 201, immediately following the table of oil well borings.

TABLE OF COAL ANALYSES

(Under the heading, "Condition of Sample," "A.D."="air dried" and "A.R."="as received.")

Mine No on Map II.	MINE	Horizon	Condition of Sample.	PROXIMATE				Common to both	ULTIMATE				Calorimeter B. T. U. for 1 lb. of Coal	Calculated B. T. U. for 1 lb. of Coal	Carbon divided by Hydrogen + Ash		
				PROXIMATE					Ash	Sulphur	Carbon	Hydrogen				Oxygen	Nitrogen
				Moisture	Volatile Matter	Fixed Carbon	Phosphorus										
1	Hamilton Coal Co.	Pittsburgh Min. Sect.	A. R.	0.47	33.69	61.65	0.009	4.19	0.84	.....	.....	.....	.....	.....	.....	.....	
2	Wm. G. Brown.	Pittsburgh Min. Sect.	A. R.	0.49	27.19	65.55	0.053	6.77	1.37	.....	.....	.....	.....	.....	.....	.....	
3	Average	Pittsburgh Min. Sect.	A. R.	0.48	30.44	63.60	0.031	5.48	1.10	.....	.....	.....	.....	.....	.....	.....	
4	F. T. Jeffers.	Elk Lick Min. Sect.	A. R.	0.69	30.93	59.32	0.058	9.06	2.75	.....	.....	.....	.....	.....	.....	.....	
5	Craig & Moore.	Elk Lick Min. Sect.	A. R.	0.40	31.97	55.10	0.012	12.53	3.57	.....	.....	.....	.....	.....	.....	.....	
6	Average	Elk Lick Min. Sect.	A. R.	0.54	31.45	57.21	0.020	10.80	3.16	.....	.....	.....	.....	.....	.....	.....	
7	W. G. Brown, Jr.	Harlem Min. Sect.	A. R.	1.55	26.57	60.14	0.006	11.74	1.72	.....	.....	.....	.....	.....	.....	.....	
8	Allison Snider.	Harlem Min. Sect.	A. R.	1.04	27.52	60.83	0.027	10.61	2.69	.....	.....	.....	.....	.....	.....	.....	
9	Average	Harlem Min. Sect.	A. R.	1.29	27.05	60.49	0.016	11.17	2.21	.....	.....	.....	.....	.....	.....	.....	
10	John Croger	Bakerstown Min. Sect.	A. R.	0.36	31.05	62.55	0.011	6.04	1.69	.....	.....	.....	.....	.....	.....	.....	
11	Craig & Moore.	Bakerstown Min. Sect.	A. R.	0.49	29.61	61.72	0.017	8.78	3.94	.....	.....	.....	.....	.....	.....	.....	
12	James Craig.	Bakerstown Min. Sect.	A. D.	0.82	28.80	65.63	0.009	4.75	0.60	.....	.....	.....	.....	.....	.....	.....	
13	James Craig.	Bakerstown Min. Sect.	A. R.	0.93	28.77	65.56	0.009	4.74	0.60	.....	.....	.....	.....	.....	.....	.....	
14	John Croger.	Bakerstown Min. Sect.	A. R.	4.06	29.75	60.24	0.009	5.95	0.47	.....	.....	.....	.....	.....	.....	.....	
15	C. N. Matlick.	Bakerstown Min. Sect.	A. R.	0.79	32.99	58.00	0.016	8.22	3.29	.....	.....	.....	.....	.....	.....	.....	
16	C. N. Matlick.	Bakerstown Min. Sect.	A. R.	0.71	23.92	45.35	0.040	30.02	0.67	.....	.....	.....	.....	.....	.....	.....	
17	Average	Bakerstown Min. Sect.	A. R.	1.33	30.31	61.61	0.012	6.75	2.00	.....	.....	.....	.....	.....	.....	.....	
18	Henry Allen.	Upper Freeport Min. Sect.	A. R.	1.07	31.10	55.04	0.012	12.79	4.71	.....	.....	.....	.....	.....	.....	.....	
19	D. W. Glover.	Upper Freeport Min. Sect.	A. R.	1.74	23.97	66.21	0.057	8.08	0.63	.....	.....	.....	.....	.....	.....	.....	
20	A. F. Walls.	Upper Freeport Min. Sect.	A. R.	1.81	24.49	63.32	0.050	10.38	2.09	.....	.....	.....	.....	.....	.....	.....	
21	L. Birtcher.	Upper Freeport Min. Sect.	A. R.	1.54	24.16	65.31	0.020	8.99	1.96	.....	.....	.....	.....	.....	.....	.....	
22	Raymond Bishop.	Upper Freeport Min. Sect.	A. R.	1.54	23.26	66.96	0.020	8.24	1.33	.....	.....	.....	.....	.....	.....	.....	
23	Harrison Calc.	Upper Freeport Min. Sect.	A. R.	1.32	22.93	68.86	0.020	6.89	0.89	.....	.....	.....	.....	.....	.....	.....	
24	Jehu Liston.	Upper Freeport Min. Sect.	A. R.	1.59	21.61	68.62	0.030	8.18	1.10	.....	.....	.....	.....	.....	.....	.....	
25	Joseph Smith.	Upper Freeport Min. Sect.	A. R.	1.32	22.93	68.86	0.030	6.89	0.89	.....	.....	.....	.....	.....	.....	.....	
26	Newton Martin	Upper Freeport Min. Sect.	A. R.	1.24	24.16	64.12	0.030	10.48	1.66	.....	.....	.....	.....	.....	.....	.....	
27	McClellan Hartman	Upper Freeport Min. Sect.	A. R.	1.59	24.21	61.89	0.010	12.31	2.08	.....	.....	.....	.....	.....	.....	.....	
28	J. W. Jackson.	Upper Freeport Min. Sect.	A. R.	1.41	22.84	67.80	0.050	7.95	1.30	.....	.....	.....	.....	.....	.....	.....	
29	Joab Groves.	Upper Freeport Min. Sect.	A. R.	1.70	21.90	68.10	0.010	8.30	0.89	.....	.....	.....	.....	.....	.....	.....	
30	George Martin	Upper Freeport Min. Sect.	A. R.	1.42	23.88	66.22	0.010	8.48	1.80	.....	.....	.....	.....	.....	.....	.....	
31	Preston County Coke Co. No. 1.	Upper Freeport Min. Sect.	A. R.	1.51	21.99	68.91	0.090	7.59	1.07	.....	.....	.....	.....	.....	.....	.....	
32	Preston County Coke Co. No. 1.	Upper Freeport Min. Sect.	A. D.	1.09	29.13	61.97	0.010	7.81	1.14	.....	.....	.....	.....	.....	.....	.....	
33	Preston County Coke Co. No. 2.	Upper Freeport Min. Sect.	A. R.	3.14	28.53	60.68	0.010	7.65	1.12	.....	.....	.....	.....	.....	.....	.....	
34	Preston County Coke Co. No. 2.	Upper Freeport Min. Sect.	A. D.	0.94	29.05	63.76	0.012	6.25	0.78	.....	.....	.....	.....	.....	.....	.....	
35	Preston County Coke Co. No. 3.	Upper Freeport Min. Sect.	A. R.	2.08	28.72	63.02	0.012	6.18	0.77	.....	.....	.....	.....	.....	.....	.....	
36	Preston County Coke Co. No. 3.	Upper Freeport Min. Sect.	A. D.	1.10	29.90	61.00	0.011	8.00	1.61	.....	.....	.....	.....	.....	.....	.....	

TABLE OF COAL ANALYSES

(Under the heading, "Condition of Sample," "A.D."="air dried" and "A.R."="as received.")

Mine No. on Map II	MINE	Horizon	Condition of Sample.	PROXIMATE				Common to both	ULTIMATE				Calorimeter B. T. U. for 1 lb. of Coal	Calculated B. T. U. for 1 lb. of Coal	Carbon divided by Oxygen + Ash						
				Moisture	Volatile Matter	Fixed Carbon	Phosphorus		Ash	Sulphur	Carbon	Hydrogen				Nitrogen					
29	Preston	County	Coke Co. No. 3.....	Upper	Freight	Min.	Sect....	A. R.	2.21	29.56	60.32	0.011	7.91	1.59	76.92	5.10	7.10	1.47	13910	13810	5.12
30	Elkins	C. & C.	No. 6 (Masonstown No. 5).....	Upper	Freight	Min.	Sect....	A. R.	0.62	27.88	65.13	0.040	6.37	0.73	80.98	4.92	5.68	1.32	11500	14120	6.75
31	Elkins	C. & C.	No. 6 (Masonstown No. 5).....	Upper	Freight	Min.	Sect....	A. R.	2.59	27.33	63.81	0.040	6.24	0.72	79.38	5.04	7.33	1.29	14210	14140	5.85
32	Elkins	C. & C.	No. 6 (Masonstown No. 4).....	Upper	Freight	Min.	Sect....	A. R.	0.54	28.04	65.35	0.018	6.07	1.09	80.20	4.98	5.43	1.51	14600	14490	7.03
33	Elkins	C. & C.	No. 2 (Hietz).....	Upper	Freight	Min.	Sect....	A. R.	3.89	27.09	63.15	0.018	6.57	1.05	78.20	5.18	2.84	1.46	14110	13990	5.96
34	Elkins	C. & C.	No. 2 (Hietz).....	Upper	Freight	Min.	Sect....	A. R.	0.71	25.76	66.99	0.024	6.42	0.66	79.10	4.83	7.47	1.40	14380	14190	6.65
35	Elkins	C. & C.	No. 2 (Hietz).....	Upper	Freight	Min.	Sect....	A. R.	2.60	25.27	65.71	0.024	6.42	0.65	77.60	4.95	9.01	1.37	14110	13920	5.03
36	Elkins	C. & C.	No. 7 (Burk No. 4).....	Upper	Freight	Min.	Sect....	A. D.	0.78	30.00	63.61	0.054	5.58	0.67	81.03	5.06	6.17	1.47	14400	14370	6.89
37	Elkins	C. & C.	No. 7 (Burk No. 2).....	Upper	Freight	Min.	Sect....	A. R.	1.90	29.66	62.92	0.054	5.52	0.66	80.12	5.12	7.11	1.47	14400	14310	7.37
38	Elkins	C. & C.	No. 7 (Burk No. 2).....	Upper	Freight	Min.	Sect....	A. D.	0.71	30.04	61.40	0.045	4.85	0.74	81.58	5.11	6.21	1.51	14670	14590	6.44
39	Elkins	C. & C.	No. 7 (Burk No. 2).....	Upper	Freight	Min.	Sect....	A. R.	2.48	29.51	63.25	0.045	4.76	0.73	80.13	5.22	7.68	1.48	14410	14330	6.64
40	Elkins	C. & C.	No. 7 (Burk No. 3).....	Upper	Freight	Min.	Sect....	A. D.	0.67	27.39	65.29	0.042	6.65	1.84	79.94	4.80	5.43	1.34	14380	14260	6.44
41	Elkins	C. & C.	No. 7 (Burk No. 3).....	Upper	Freight	Min.	Sect....	A. R.	1.66	27.12	64.64	0.042	6.58	1.82	79.14	4.86	6.28	1.32	14240	14120	6.16
42	Elkins	C. & C.	No. 7 (Burk No. 1).....	Upper	Freight	Min.	Sect....	A. R.	0.70	28.69	63.47	0.060	7.14	0.85	79.39	4.77	6.51	1.31	14290	14200	5.80
43	Elkins	C. & C.	No. 7 (Burk No. 1).....	Upper	Freight	Min.	Sect....	A. R.	2.55	28.16	62.29	0.060	7.00	0.84	77.92	4.89	8.07	1.28	14050	13760	5.17
44	Elkins	C. & C.	No. 4 (Kingwood).....	Upper	Freight	Min.	Sect....	A. D.	1.30	28.10	63.84	0.023	6.76	1.30	80.41	4.91	5.41	1.21	14515	14373	6.67
45	Elkins	C. & C.	No. 4 (Kingwood).....	Upper	Freight	Min.	Sect....	A. R.	1.64	28.01	63.61	0.023	6.74	1.30	80.14	4.95	5.66	1.21	14406	14335	6.46
46	W. H. Sypholt.....			Upper	Freight	Min.	Sect....	A. R.	0.42	26.81	65.42	0.015	7.35	1.01	77.79	4.91	5.43	1.27	14020	13990	5.31
47	Irona	Coal Co.		Upper	Freight	Min.	Sect....	A. D.	0.48	28.69	61.62	0.013	9.21	1.39	77.79	4.91	5.43	1.27	14020	13990	5.31
48	Borgman	Coal Co.		Upper	Freight	Min.	Sect....	A. R.	0.48	28.69	61.62	0.013	9.21	1.39	77.79	4.91	5.43	1.27	14020	13990	5.31
49	Kingwood	Coal Co.		Upper	Freight	Min.	Sect....	A. D.	0.68	28.58	61.59	0.011	6.15	0.87	80.71	5.00	5.93	1.34	14430	14420	6.68
50	Kingwood	Coal Co.		Upper	Freight	Min.	Sect....	A. R.	0.68	28.58	61.59	0.011	6.15	0.87	80.71	5.00	5.93	1.34	14430	14420	6.68
51	Kingwood	Coal Co.	No. 1.....	Upper	Freight	Min.	Sect....	A. D.	0.91	30.47	54.95	0.007	13.67	3.63	70.75	4.83	5.69	1.43	13360	13170	3.60
52	Kingwood	Coal Co.	No. 1.....	Upper	Freight	Min.	Sect....	A. R.	2.75	29.91	53.92	0.007	13.42	3.56	69.43	4.94	7.25	1.40	13110	12930	3.36
53	Kingwood	Coal Co.	No. 2.....	Upper	Freight	Min.	Sect....	A. D.	0.74	31.72	55.20	0.006	12.34	4.48	72.73	4.85	4.36	1.24	13380	13430	4.36
54	Kingwood	Coal Co.	No. 2.....	Upper	Freight	Min.	Sect....	A. R.	0.74	31.72	55.20	0.006	12.34	4.48	72.73	4.85	4.36	1.24	13380	13430	4.36
55	S. H. Volyard.....			Upper	Freight	Min.	Sect....	A. R.	0.42	29.47	55.15	0.025	14.96	5.39	74.79	4.96	6.41	1.24	13360	13430	4.36
56	Va.-Md. Coal Corporation.....			Upper	Freight	Min.	Sect....	A. R.	0.76	28.33	61.09	0.008	9.82	2.75	74.79	4.96	6.41	1.24	13370	13570	4.36
57	Va.-Md. Coal Corporation.....			Upper	Freight	Min.	Sect....	A. R.	1.83	28.03	63.43	0.008	9.71	2.72	73.98	5.03	7.33	1.23	13630	13470	4.34
58	Hiorra	Coal Co.		Upper	Freight	Min.	Sect....	A. D.	1.06	29.50	61.65	0.088	7.79	0.76	78.80	4.72	6.53	1.40	14100	13920	5.52
59	Hiorra	Coal Co.		Upper	Freight	Min.	Sect....	A. R.	4.51	28.47	59.50	0.088	7.52	0.73	76.05	4.95	9.40	1.35	13610	13440	4.43
60	Hite	Coal & Coke Co.		Upper	Freight	Min.	Sect....	A. D.	0.89	31.70	58.73	0.058	8.68	2.23	76.95	4.79	5.91	1.44	13970	13530	4.59
61	Hite	Coal & Coke Co.		Upper	Freight	Min.	Sect....	A. R.	1.20	31.61	58.54	0.058	8.65	2.22	76.72	4.79	6.11	1.44	13930	13790	5.16
62	Austen	Coal & C. Co. No. 2.....		Upper	Freight	Min.	Sect....	A. D.	0.77	31.19	61.05	0.083	6.99	1.06	79.65	5.05	5.95	1.30	14380	14290	6.16
63	Austen	Coal & C. Co. No. 2.....		Upper	Freight	Min.	Sect....	A. R.	2.31	30.71	60.10	0.083	8.88	1.04	78.42	5.14	7.24	1.28	14160	13980	5.55
64	Austen	Coal & C. Co. No. 1.....		Upper	Freight	Min.	Sect....	A. R.	0.72	29.91	62.06	0.077	8.21	0.80	78.57	4.98	5.86	1.41	14710	14100	5.51
65	Austen	Coal & C. Co. No. 1.....		Upper	Freight	Min.	Sect....	A. R.	2.04	28.53	61.23	0.077	8.30	0.80	77.63	5.06	6.95	1.48	13950	13920	6.13
66	Gorman	C. & C. Co. No. 4.....		Upper	Freight	Min.	Sect....	A. R.	0.73	30.49	62.15	0.042	6.63	0.87	80.13	4.96	6.01	1.32	14360	14300	6.30

TABLE OF COAL ANALYSES

(Under the heading, "Condition of Sample," "A.D."="air dried" and "A.R."="as received.")

Mine No. on Map II	MINE	Horizon	Condition of Sample.	PROXIMATE				Common to both		ULTIMATE				Calorimeter B. T. U. for 1 lb. of Coal	Calculated B. T. U. for 1 lb. of Coal	Carbon divided by Oxygen + Ash
				PROXIMATE				Ash	Sulphur	Carbon	Hydrogen	Oxygen	Nitrogen			
				Moisture	Volatile Matter	Fixed Carbon	Phosphorus									
49	Gorman C. & C. Co. No. 4.	Upper	Freeport Min. Sect. . . .	1.78	30.17	61.49	0.042	6.56	0.87	79.28	5.03	6.95	1.31	14210	14150	5.80
50	Gorman C. & C. Co. No. 2.	Upper	Freeport Min. Sect. . . .	0.83	31.39	61.09	0.044	6.79	0.88	79.32	5.19	6.33	1.49	14400	14300	6.05
50	Gorman C. & C. Co. No. 2.	Upper	Freeport Min. Sect. . . .	1.82	30.98	60.48	0.044	6.72	0.87	78.52	5.25	7.16	1.48	14300	14160	5.66
51	Gorman C. & C. Co. No. 3.	Upper	Freeport Min. Sect. . . .	1.06	30.51	57.25	0.009	11.18	2.28	74.07	4.72	6.49	1.25	13590	13300	4.19
51	Gorman C. & C. Co. No. 3.	Upper	Freeport Min. Sect. . . .	2.79	29.98	56.25	0.009	10.98	2.24	72.78	4.84	7.93	1.23	13350	13070	3.85
52	Gorman C. & C. Co. No. 1.	Upper	Freeport Min. Sect. . . .	1.00	30.25	59.02	0.007	9.73	1.22	76.53	5.08	6.13	1.31	13960	13850	4.82
52	Gorman C. & C. Co. No. 1.	Upper	Freeport Min. Sect. . . .	3.31	29.54	57.65	0.007	9.60	1.19	74.75	5.22	8.06	1.28	13640	13520	4.28
53	Merchants Coal Co.	Upper	Freeport Min. Sect. . . .	0.31	30.82	61.15	0.006	7.72	2.53	77.73	4.99	5.80	1.23	14080	14060	5.75
53	Merchants Coal Co.	Upper	Freeport Min. Sect. . . .	1.98	39.58	60.68	0.006	7.66	2.51	77.13	5.03	6.45	1.22	13970	13960	5.47
54	Atlantic C. & C. Co.	Upper	Freeport Min. Sect. . . .	0.40	29.19	63.12	0.024	7.29	2.24	78.30	4.97	5.95	1.25	14230	14100	5.91
54	Atlantic C. & C. Co.	Upper	Freeport Min. Sect. . . .	1.47	28.88	62.44	0.024	7.21	2.22	77.46	5.04	6.83	1.24	14080	13950	5.51
55	Average	Upper	Freeport Min. Sect. . . .	0.79	29.45	61.91	0.032	7.85	1.51	78.35	4.95	5.98	1.36	14178	13967	5.66
55	Amos Moyers	Upper	Freeport Min. Sect. . . .	1.83	27.25	62.52	0.029	8.40	1.69	77.28	5.02	7.09	1.35	13959	13879	4.99
56	George Jefferson	Lower	Freeport Min. Sect. . . .	1.02	25.69	63.68	0.024	9.01	3.09							
56	George Jefferson	Lower	Freeport Min. Sect. . . .	1.27	22.33	55.14	0.002	21.26	3.95							
57	Average	Lower	Freeport Min. Sect. . . .	1.15	24.01	59.41	0.013	15.43	3.52							
57	Thurmond King	Upper	Kittanning Min. Sect. . . .	1.16	27.54	65.83	0.013	5.47	2.48							
57	Thurmond King	Upper	Kittanning Top Ply. Sect. . . .	0.81	27.78	61.75	0.017	9.66	1.97							
57	Thurmond King	Upper	Kittanning Bottom Ply. Sect. . . .	0.97	26.99	64.60	0.014	7.44	3.78							
58	William Miller	Upper	Kittanning Min. Sect. . . .	0.70	24.55	66.10	0.049	8.25	2.06							
59	J. F. Leraw	Upper	Kittanning Min. Sect. . . .	0.44	27.40	64.49	0.035	7.67	1.04							
59	J. W. Feather	Upper	Kittanning Min. Sect. . . .	1.09	26.77	55.26	0.009	16.88	4.67							
60	J. W. Feather	Upper	Kittanning Cannel. Sect. . . .	0.54	21.50	52.57	0.008	25.09	1.27							
61	Hamilton Coal Co.	Upper	Kittanning Min. Sect. . . .	0.46	29.97	58.76	0.049	10.81	1.66							
62	L. B. Brydon.	Upper	Kittanning Min. Sect. . . .	0.86	29.39	58.64	0.055	11.11	2.80							
62	L. B. Brydon.	Upper	Kittanning Min. Sect. . . .	2.31	28.96	57.78	0.055	10.95	2.76							
63	Irvington-Late Coal Co.	Upper	Kittanning Min. Sect. . . .	0.86	30.18	58.41	0.032	10.55	1.94							
63	Irvington-Late Coal Co.	Upper	Kittanning Min. Sect. . . .	1.54	29.98	58.00	0.032	10.48	1.92							
63	Irvington-Late Coal Co.	Upper	Kittanning Min. Sect. . . .	0.86	29.78	58.53	0.033	10.83	2.37							
64	Average	Upper	Kittanning Min. Sect. . . .	1.10	27.94	60.89	0.037	10.07	2.37							
64	Alex. Fike	Lower	Kittanning Min. Sect. . . .	0.86	26.60	65.28	0.004	7.26	1.22							
65	White	Lower	Kittanning Min. Sect. . . .	0.27	29.48	67.57	0.130	9.68	0.69							
66	L. B. Brydon.	Lower	Kittanning Min. Sect. . . .	0.53	31.67	55.18	0.053	12.62	2.07							
66	L. B. Brydon.	Lower	Kittanning Min. Sect. . . .	1.07	31.60	54.87	0.053	12.56	2.06							
67	Irvington-Late Coal Co.	Lower	Kittanning Min. Sect. . . .	0.51	28.91	56.87	0.148	13.71	2.02							
67	Irvington-Late Coal Co.	Lower	Kittanning Min. Sect. . . .	1.73	28.55	56.18	0.148	13.54	2.00							

TABLE OF COAL ANALYSES

(Under the heading, "Condition of Sample," "A.D."="air dried" and "A.R."="as received.")

Mine No. on Map II	MINE	Horizon	Condition of Sample.	PROXIMATE					Common to both		ULTIMATE				Calorimeter B. T. U. for 1 lb. of Coal	Calculated B. T. U. for 1 lb. of Coal	Carbon divided by Oxygen + Ash		
				Moisture			Fixed Carbon	Phosphorus			Ash	Sulphur	Carbon	Hydrogen				Oxygen	Nitrogen
				Volatile Matter	Moisture	Phosphorus													
68	L. B. Brydon.	Lower Kittanning	A. D.	0.48	26.25	60.51	0.102	8.76	1.72	78.94	5.08	4.11	1.39	14320	14390	6.13			
68	L. B. Brydon.	Lower Kittanning	A. R.	2.50	29.64	59.28	0.102	8.58	1.69	77.34	5.20	5.83	1.36	14030	14100	6.36			
69	Preston Fuel Co.	Lower Kittanning	A. D.	0.41	31.48	60.28	0.063	7.83	1.43	75.53	4.92	5.93	1.30	14250	14070	5.71			
69	Preston Fuel Co.	Lower Kittanning	A. R.	2.46	30.84	59.04	0.063	7.66	1.40	76.92	5.05	7.64	1.33	13960	13780	5.03			
70	Va.-Md. Coal Corporation.	Lower Kittanning	A. D.	0.50	29.42	61.97	0.063	8.11	1.13	78.93	4.93	5.46	1.44	14260	14160	5.82			
71	Jonathan Funk	Lower Kittanning	A. R.	0.29	29.33	61.77	0.063	8.08	1.13	78.68	4.94	5.73	1.44	14210	14120	5.69			
72	S. M. Jones.	Lower Kittanning	A. R.	1.63	28.77	59.79	0.010	9.81	0.80	.....	.....	.....	.....	.....	.....	.....			
72	S. M. Jones.	Lower Kittanning	A. R.	0.72	32.78	54.93	0.174	11.52	1.63	.....	.....	.....	.....	.....	.....	.....			
73	S. M. Jones.	Lower Kittanning	A. R.	0.97	31.69	61.28	0.025	8.66	0.89	.....	.....	.....	.....	.....	.....	.....			
73	H. C. Reatty.	Lower Kittanning	A. R.	1.17	26.95	63.38	0.018	8.50	1.66	.....	.....	.....	.....	.....	.....	.....			
76	A. C. Lull.	Lower Kittanning	A. R.	1.58	27.82	59.44	0.008	11.10	2.88	.....	.....	.....	.....	.....	.....	.....			
77	John Willis	Lower Kittanning	A. D.	1.06	25.38	66.49	0.011	7.07	1.13	80.13	4.92	5.41	1.34	14330	14240	6.43			
77	John Willis	Lower Kittanning	A. R.	3.34	24.80	64.95	0.011	6.91	1.10	78.27	5.07	7.34	1.31	14000	14180	5.42			
78	Nordeck Bros.	Lower Kittanning	A. D.	1.12	23.63	68.46	0.024	6.79	0.56	80.86	4.58	5.79	1.42	14290	14150	6.43			
78	Nordeck Bros.	Lower Kittanning	A. R.	4.24	22.89	66.30	0.024	6.57	0.54	78.30	4.79	8.42	1.38	13840	13740	4.22			
79	Crane Hrs.	Lower Kittanning	Top Sect.	2.20	24.09	67.05	0.094	6.66	0.52	.....	.....	.....	.....	.....	.....	.....			
79	Crane Hrs.	Lower Kittanning	Bottom Sect.	1.06	22.56	63.63	0.030	12.75	0.57	.....	.....	.....	.....	.....	.....	.....			
80	Kendall Lumber Co.	Lower Kittanning	A. D.	0.76	24.18	69.08	0.041	5.98	0.63	80.88	4.47	6.70	1.34	14210	14040	6.28			
80	Kendall Lumber Co.	Lower Kittanning	A. R.	2.96	23.64	67.55	0.041	5.85	0.62	79.08	4.61	8.53	1.31	13900	13730	5.91			
81	Wm. Ashler	Lower Kittanning	Top Sect.	1.15	22.13	68.96	0.018	7.76	2.46	.....	.....	.....	.....	.....	.....	.....			
81	Wm. Ashler	Lower Kittanning	Bottom Sect.	1.00	18.80	54.05	0.013	26.15	1.70	.....	.....	.....	.....	.....	.....	.....			
Average				A. D.	0.95	28.05	62.16	0.063	8.84	1.33	77.73	4.79	5.92	1.39	13978	13872	5.48		
Average				A. R.	1.93	28.35	60.80	0.058	8.92	1.36	76.69	4.88	7.13	1.37	13777	13670	4.86		
Average				A. R.	1.67	23.11	68.01	0.050	7.21	1.49									
Average				A. R.	1.03	20.68	68.84	0.022	19.45	1.14									
82	Zachaeus Gibson	Clarion Min. Sect.	A. R.	0.85	28.64	59.63	0.044	10.88	3.27	74.73	4.89	5.10	1.13	13800	13640	4.68			
83	James Bircher	Clarion Min. Sect.	A. R.	2.11	22.19	67.11	0.030	7.99	1.96	.....	.....	.....	.....	.....	.....	.....			
84	Silas Metheny	Clarion Min. Sect.	A. R.	0.46	30.91	58.90	0.013	9.73	1.65	.....	.....	.....	.....	.....	.....	.....			
85	Chas. Rhodelheaver	Clarion Min. Sect.	A. R.	1.81	27.00	63.20	0.006	7.99	0.81	.....	.....	.....	.....	.....	.....	.....			
86	Arthur Savage	Clarion Min. Sect.	A. R.	1.26	28.06	53.27	0.008	17.41	2.21	.....	.....	.....	.....	.....	.....	.....			
Average				A. R.	1.30	27.35	60.50	0.020	10.80	1.98									
87	Silas Metheny	Quakertown Min. Sect.	A. R.	0.53	16.93	21.10	0.118	61.44	5.50	.....	.....	.....	.....	.....	.....	.....			
88	Harry Reckart.	Quakertown Min. Sect.	A. R.	1.48	23.65	59.01	0.062	15.86	0.70	.....	.....	.....	.....	.....	.....	.....			
89	Gibson Hrs.	Quakertown Min. Sect.	A. R.	1.00	20.29	40.06	0.090	38.65	3.10	.....	.....	.....	.....	.....	.....	.....			
89	Gibson Hrs.	Sharon Min. Sect.	A. R.	1.80	27.84	61.31	0.008	9.05	0.78	.....	.....	.....	.....	.....	.....	.....			

Page Reference to Detailed Description and Section of Coal
Mines Listed in Preceding Table.

Map No.	Laboratory No.	Property	Page of this Report
1	759H	Hamilton Coal Co.....	108
2	755H	Wm. G. Brown.....	110
3	805H	F. T. Jeffers.....	123
4	758H	Craig & Moore.....	121
5	801H	W. G. Brown, Jr.....	130
6	753H	Allison Snider.....	130
8	751H	John Croger.....	137
9	756H	Craig & Moore.....	137
10	845H	James Craig.....	137
11	750H	John Crogan.....	136
12	763H		
	764H	C. N. Matlick.....	139
13	786H	Henry Allen.....	271
14	788H	D. W. Glover.....	274
15	R. V. H. No. 1 II(A) p. 597	A. F. Walls.....	273
16	R. V. H. No. 3 II(A) p. 598	L. Birtcher.....	273
17	R. V. H. No. 21 II(A) p. 608	Raymond Bishop.....	279
18	R. V. H. No. 23 II(A) p. 608	Harrison Cale.....	279
19	R. V. H. No. 10 II(A) p. 602	Jehu Liston.....	280
20	R. V. H. No. 11 II(A) p. 603	Joseph Smith.....	281
21	R. V. H. No. 7 II(A) p. 601	Newton Martin.....	281
22	R. V. H. No. 8 II(A) p. 601	McClellan Hartman.....	281
23	R. V. H. No. 9 II(A) p. 602	J. W. Jackson.....	282
24	R. V. H. No. 19 II(A) p. 607	Jackson Martin.....	282
25	R. V. H. No. 20 II(A) p. 607	Joab Croves.....	283
26	R. V. H. No. 18 II(A) p. 606	George Martin.....	283
27	847H Coke	Preston Coke Co. No. 1.....	287
28	848H	Preston Coke Co. No. 2.....	288
29	846H	Preston Coke Co. No. 3.....	288
30	854H	Elkins C. & C. Co. No. 6 (Masontown No. 5).....	288
31	855H	Elkins C. & C. Co. (Masontown No. 4).....	289
32	Vol. II(A) p. 530. No. 23 856H Coke	Elkins C. & C. Co. No. 2 (Bretz).....	289



PLATE XXXVI(a).—Old Valley (Douglas) Furnace in northwest corner of Preston County. Topography affected by rocks of the Pocono Series.



PLATE XXXVI(b).—Showing tipples at shaft mine of the Hamilton Coal & Coke Co. at Newburg and topography of the Conemaugh Series.

Map No.	Laboratory No.	Property	Page of this Report
33	853H	Elkins C. & C. Co. No. 7 (Burk No. 4).....	290
34	852H	Elkins C. & C. Co. No. 7 (Burk No. 2).....	290
35	851H	Elkins C. & C. Co. No. 7 (Burk No. 3).....	291
36	850H	Elkins C. & C. Co. No. 7 (Burk No. 1).....	291
37	II(A) p. 530	Elkins C. & C. Co. No. 4 (Kingwood)	301
38	754H	W. H. Sypholt.....	309
39	II, p. 409		
	844H	Irona Coal Co.....	301
40	843H	Borgman Coal Co.....	301
41	II, p. 408		
	841H	Kingwood Coal Co. No. 1.....	302
42	842H	Kingwood Coal Co. No. 2.....	302
43	761H	S. H. Volyard.....	293
44	II, p. 412		
	836H	Va.-Md. Coal Corp.....	295
45	II, p. 411		
	834H	Hiorra Coke Co.....	295
46	II, p. 411		
	833H	Hite Coal & Coke Co.....	296
47	830H	Austen C. & C. Co. No. 2.....	296
48	II, p. 411		
	832H Coke	Austen C. & C. Co. No. 1.....	296
49	828H	Gorman C. & C. Co. No. 4.....	296
50	II, p. 410		
	827H Coke	Gorman C. & C. Co. No. 2.....	303
51	826H	Gorman C. & C. Co. No. 3.....	303
52	II, p. 410		
	829H	Gorman C. & C. Co. No. 1.....	306
53	II, p. 409		
	825H	Merchants Coal Co.....	306
54	824H	Atlantic C. & C. Co.....	304
55	790H	Amos Moyers.....	160
56	R. V. H. No. 16		
	II(A) p. 605	George Jefferson.....	163
57	R. V. H. No. 6		
	II(A) p. 599	Thurmond King.....	314
58	747H	Wm. Miller.....	314
59	779H	J. F. Loraw.....	315
60	741H		
	742H	J. W. Feather.....	317
61	760H	Hamilton Coal Co.....	319
62	838H	L. B. Brydon.....	319
63	840H	Irvington-Late Coal Co.....	320
64	787H	Alex. Fike.....	327
65	813H	White	329
66	837H	L. B. Brydon.....	332
67	839H	Irvington-Late Coal Co.....	332

Map No.	Laboratory No.	Property	Page of this Report
68	859H	L. B. Brydon.....	333
69	858H	Preston Fuel Co.....	333
70	835H	Va.-Md. Coal Corp.....	334
71	766H	Jonathan Funk.....	340
72	768H	S. M. Jones.....	340
73	767H	S. M. Jones.....	340
75	804H	H. C. Beatty.....	343
76	784H	A. C. Lull.....	342
77	II, p. 485		
	821H	John Wills.....	343
78	822H	Nordeck Bros.....	344
79	774H(a) top		
79	774H(a) bottom	Crane Heirs.....	345
80	823H	Kendall Lumber Co.....	347
81	795H top		
	795H(a) bottom	Wm. Ashler.....	345
82	634H		
	MMT p. 362	Zacheus Gibson.....	354
83	R. V. H. No. 4		
	II(A) p. 598	James Birtcher.....	349
84	778H	Silas Metheny.....	352
85	793H	Chas. Rhodeheaver.....	352
86	791H	Arthur Savage.....	353
87	744H	Silas Metheny.....	181
88	792H	Henry Reckart.....	182
89	745H	Gibson Heirs.....	184

CHAPTER XIII.

CLAYS, LIMESTONE AND ROAD MATERIAL.

CLAY.

A general review of the clay industry of the State, along with an exhaustive discussion of the origin, physical and chemical properties, and classification of clays therein, is given in Volume III of the State Geological Survey Reports by G. P. Grimsley, to which reference is made for such data and the technology of the industry.

Absence of Development.

Although Preston contains an almost inexhaustible quantity of fine fire clay, yet there is not a single brick or pottery plant utilizing either clays or shales within the county. This state of affairs is very probably due to the tendencies of such industries in West Virginia to seek locations convenient to sources of natural gas for fuel. It is true that Kingwood possesses a plant (See page 35) that manufactures cement brick along with concrete blocks and steps, but clay and shale are not directly utilized in the process.

Available Clay.

Transported Clays.

Clays that have been carried to new locations from their original home by the forces of nature—water, ice and wind—have been divided into three classes; viz, **alluvial**, **glacial** and **loess**. Owing to the absence of glacial action in Preston, the latter two do not occur in the county.

Alluvial Clay.—The alluvial clays of Preston are quite recent in their origin and represent the terrace and flood plain deposits along Cheat river and its larger tributaries. Their areal extent is exhibited by the Quaternary as outlined on Map II, an examination of which will show their existence in almost inexhaustible quantity. Along Cheat river it is very probable that these deposits contain too great a proportion of sand and boulders to be successfully worked, but along its larger tributaries which flow over the more argillaceous rocks of the Conemaugh and Allegheny series, there should be an abundance of alluvial clay adapted to the manufacture of building and paving brick. Favorable points along Big Sandy occur just below Bruceton Mills and in the vicinity of Clifton Mills; along Deckers creek, between Bretz and Reedsville; and Little Sandy, between Evansville and Fellowsville.

Shale.

Excellent shale for the manufacture of brick occurs in abundance in every district of the county. In the Conemaugh series five to ten feet of fire clay shale, belonging immediately below the Harlem and Brush Creek coals, is very persistent in Preston and should make a fine brick in which high refractory qualities are not essential. The **Pittsburgh red shale** of the same measures is widely distributed and has a good reputation in other counties of the State for both building and paving brick. The areal distribution of these horizons can readily be ascertained, as they closely accompany the Bakerstown coal, the crop of which is indicated on Map II. The **Mauch Chunk** and **Catskill red shales** offer an unlimited amount of material for the same kind of brick. These have been fully described in Chapters IX and X, and their detailed crops are shown by appropriate symbols on Map II. The composition of the former shale is exhibited in the following analysis by Ries* from a sample collected in Deckers creek gorge, 2.5 miles westward from the Preston area, and re-published on page 757 of the Monongalia-Marion-Taylor Report of the State Geological Survey:

*Dr. Heinrich Ries; Clays, Their Occurrence and Uses, page 502; 1908.

	Per cent.
Silica (SiO_2).....	56.30
Alumina (Al_2O_3).....	19.07
Ferric Oxide (Fe_2O_3).....	9.58
Lime (CaO).....	0.69
Magnesium (MgO).....	2.01
Titanic Oxide (TiO_2).....	0.71
Loss on ignition.....	8.01
Total	96.37

Owing to high percentage of iron, this shale should burn into a rich red colored brick often desired for building purposes.

The same should be true of the Catskill red shale as shown by the analysis of a sample collected by Reger near Rowlesburg, published under the description of these beds, page 190.

Fire Clay.

The principal fire clays of Preston county are the Thornton in the Conemaugh series; the Bolivar, Upper Kittanning, Hardman and Lower Kittanning in the Allegheny; and the Mt. Savage in the Pottsville. All are of excellent quality and should burn into wares of a highly refractory character. These will now be discussed in descending order.

Thornton Fire Clay.—This clay, described in Chapter VI, pages 148-149, attains a fine development in Preston county and is widely persistent. As noted in the reference given, a section is published where this clay crops in the bed of Stony run in the northeastern corner of Lyon district, $\frac{1}{4}$ mile southwest of Browns Mills, where a sample for analysis was collected by Hennen, the composition of which is reported under Lab. No. 757H by Messrs. Hite and Krak as follows:

	Per cent.
Silica (SiO_2).....	62.96
Ferric Iron (Fe_2O_3).....	2.40
Alumina (Al_2O_3).....	22.62
Lime (CaO).....	0.43
Magnesia (MgO).....	0.72
Sodium (Na_2O).....	0.28
Potassium (K_2O).....	2.64
Titanium (TiO_2).....	0.40
Phosphoric Acid (P_2O_5).....	0.10
Moisture	1.21
Loss on ignition.....	6.69
Total	100.45

In the extreme eastern edge of Lyon district, Reger collected a sample of this clay for analysis and measured the section, published on page 149, at its crop along the Baltimore & Ohio railroad grade. The composition, as reported by Messrs. Ilite and Krak under Laboratory No. 749H, is as follows:

	Per cent.
Silica (SiO_2).....	58.93
Ferric Iron (Fe_2O_3).....	2.20
Alumina (Al_2O_3).....	25.48
Lime (CaO).....	0.83
Magnesia (MgO).....	0.51
Sodium (Na_2O).....	0.87
Potassium (K_2O).....	3.45
Titanium (TiO_2).....	0.39
Phosphoric Acid (P_2O_5).....	0.08
Moisture	0.82
Loss on ignition.....	5.99
Total	99.55

The alkalies, important fluxing agents represented by the soda and potash, in the two foregoing samples, are sufficiently low to class the same as fire clays.

Bolivar Fire Clay.—This is a very important fire clay in the Preston area. Its character and composition in a sample collected in the western portion of the county near Pisgah are discussed in Chapter VII, pages 154-155. In areal extent it should follow closely the same regions as outlined on Map II for the Upper Freeport coal.

Upper Kittanning Fire Clay.—A brief description of the Upper Kittanning clay is given in Chapter VII, page 171. It is fairly persistent in Preston, but no samples were collected. Its composition in a sample on the Preston-Monongalia line, one mile northwest of Cascade, as published on page 344 of the Monongalia-Marion-Taylor Report of the State Geological Survey, is as follows:

Prospect Mine—Knowlton and Ford.

	Ft.	In.
1. Slate, black, hard, Upper Kittanning coal.....	3	0
2. Fire clay, plastic.....	2	0
3. Fire clay flint, Upper Kittanning.....	9	0
4. Sandstone, hard, 10" to.....	1	0
5. Fire clay, flint, Hardman.....	2	0
6. Sandstone, hard	0	4
7. Fire clay, dark gray, plastic.....	14	0
(Elevation of coal, 1980' A. T., aneroid).		

"The large body of flint fire clay that appears in No. 3 of section has not been previously noted in the detailed county reports and will therefore be called the **Upper Kittanning Fire Clay**.

"Samples collected from No. 3, 5 and 7 showed the following analyses according to Messrs. Hite and Krak:

	No. 3 Per cent.	No. 5 Per cent.	No. 7 Per cent.
Silica (SiO_2).....	57.78	41.00	56.56
Ferric Iron (Fe_2O_3).....	1.24	1.88	2.35
Alumina (Al_2O_3).....	28.60	38.28	27.21
Lime (CaO).....	0.37	1.88	0.37
Magnesia (MgO).....	0.17	0.35	0.26
Sodium (Na_2O).....	0.34	0.31	0.49
Potassium (K_2O).....	0.31	0.14	1.76
Titanium (TiO_2).....	0.29	0.28	0.30
Phosphoric Acid (P_2O_5).....	0.10	0.50	0.07
Moisture	0.86	1.85	0.93
Loss on ignition.....	10.85	13.08	9.45
Totals	100.91	99.55	99.75"

The results show it an exceptional clay that should burn into brick of exceedingly high heat resisting qualities. Its areal extent should follow closely the same regions as outlined for the crop of the Upper Kittanning coal on Map II.

Hardman Fire Clay.—The Hardman fire clay, described briefly in Chapter VII, page 172, attains a fine development in Preston, and is quite persistent throughout the crop of its horizon in the county. At its type locality separate samples of the plastic and flint clays (See section, page 172) were collected by Hennen at the **J. H. Irving Clay Mine**, $\frac{3}{4}$ mile north of Hardman station in the western edge of Lyon district, the compositions of which, as reported by Messrs. Hite and Krak, under Laboratory Nos. 771H and 772H, respectively, are as follows:

	Plastic Per cent.	Flint Per cent.
Silica (SiO_2).....	61.33	52.84
Ferric Iron (Fe_2O_3).....	2.83	2.86
Alumina (Al_2O_3).....	22.33	29.01
Lime (CaO).....	0.62	1.07
Magnesia (MgO).....	0.81	0.01
Soda (Na_2O).....	0.45	0.39
Potassa (K_2O).....	3.43	0.50
Titanium (TiO_2).....	0.92	0.94
Phosphoric Acid (P_2O_5).....	0.62	0.83
Moisture	1.06	1.23
Loss on ignition.....	5.89	10.93
Totals	100.29	100.61

Only the plastic clay was being mined by Mr. Irving, the plant having an output of about 25 tons daily, all of which is shipped to the West Virginia Pottery Company at Bridgeport, and the A. Radford Pottery Company at Clarksburg, Harrison county, where it gives highly satisfactory results in the manufacture of jugs, umbrella stands and jardinières. The flint analysis reveals a high grade clay which should burn into ware possessing considerable heat resisting qualities.

Reger measured the following section at the crop of this clay where it is exposed in a hollow on the land of Thomas Dunn, along the east hillside of Cheat river, $\frac{1}{2}$ mile southward from St. Joe:

	Ft.	In.
1. Shale, gray and sandy.....	10	0
2. Coal, good, Upper Kittanning.....	1	8
3. Slate, black.....	1	0
4. Shale, gray, with nuggets of ferriferous limestone	15	0
5. Shale, sandy and dark.....	30	0
6. Fire clay, flinty, Hardman.....	10	0
7. Concealed to road.....	45	0
(Elevation of clay, 1290' A. T., aneroid measurement).		

The composition of a sample collected at this point by R. W. Gearhart, as reported by Messrs. Hite and Krak under Laboratory No. 748H, is as follows:

	Per cent.
Silica (SiO_2).....	55.07
Ferric Iron (Fe_2O_3).....	1.54
Alumina (Al_2O_3).....	30.05
Lime (CaO).....	0.46
Magnesia (MgO).....	0.30
Soda (Na_2O).....	0.11
Potassa (K_2O).....	1.27
Titanium (TiO_2).....	0.83
Phosphoric Acid (P_2O_5).....	0.12
Moisture	1.80
Loss on ignition.....	9.08
Total	100.63

The result reveals a high grade fire clay which should produce wares possessing good refractory qualities, due to the low percentage of the easily fusible components.

Lower Kittanning Fire Clay.—A brief description of the Lower Kittanning fire clay and the area of its crop has already been given in Chapter VII, page 174. The composition of the



PLATE XXXVII(a).—Showing Falls of Big Sandy Creek at Rockville flowing over ledge of Upper Connoquenessing Sandstone.



PLATE XXXVII(b).—Showing Upper Falls of Big Sandy, 1.1 miles NW. of Rockville, at comparatively high water stage, flowing over Upper Connoquenessing Sandstone.

sample for analysis, mentioned therein, as reported by Messrs. Hite and Krak under Laboratory No. 743H, is as follows:

	Per cent.
Silica (SiO_2).....	64.36
Ferric Iron (Fe_2O_3).....	3.95
Alumina (Al_2O_3).....	19.14
Lime (CaO).....	0.42
Magnesia (MgO).....	1.15
Soda (Na_2O).....	0.30
Potassa (K_2O).....	3.08
Titanium (TiO_2).....	0.62
Phosphoric Acid (P_2O_5).....	0.19
Moisture	0.71
Loss on ignition.....	6.50
Total	100.42

The results reveal a fair clay, although a little low in alumina and high in potassa as compared with the last above given for the Hardman clay.

Mount Savage Fire Clay.—The Mount Savage fire clay, described briefly in Chapter VIII, page 179, attains fair development in Preston. Reger collected samples for analysis at two different exposures of this clay, the composition and location of which are as follows:

	Lab. No. 781H Per cent.	Lab. No. 820Hc Per cent.
Silica (SiO_2).....	61.70	65.70
Ferric Iron (Fe_2O_3).....	1.43	1.38
Alumina (Al_2O_3).....	25.73	22.99
Lime (CaO).....	0.53	0.32
Magnesia (MgO).....	0.10	0.05
Soda (Na_2O).....	0.26	0.19
Potassa (K_2O).....	0.24	0.16
Titanium (TiO_2).....	0.98	0.32
Phosphoric Acid (P_2O_5).....	0.61	0.15
Moisture	0.69	0.72
Loss on ignition.....	8.28	8.48
Totals	100.55	100.46

No. 781H.—From crop in private road, 3.6 miles northward from Cranesville and 1.4 miles southeast of Coal Mine No. 85 on Map II; reported by Reger as hard and flinty and 1 to 2 feet thick; elevation, 2590' A. T., aneroid measurement.

No. 820Hc.—Located on the land of J. F. Stoer, 1.5 miles southeast of Morlan station; one foot visible, very hard and pure; elevation, 2455' A. T., aneroid measurement.

The results show the Mt. Savage fire clay comparing favorably with the Upper Kittanning and Hardman in the low percentage of fusible components.

For the benefit of the reader in interpreting the analyses of the foregoing shales and clays in Preston county, the authors have compiled the following table from results published on pages 13-19 inclusive, of Volume III of the State Geological Reports, which shows the **minimum, maximum and average** percentages of the indicated components permissible in clays adapted to the manufacture of ordinary **building and paving brick, pottery, and fire brick** or other ware requiring high refractory qualities. A glance at the shale and clay analyses on preceding pages and the results in this table will readily show in what class the sample belongs:

	BRICK CLAYS.			POTTERY CLAYS.			FIRE CLAYS.		
	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.
Silica (SiO_2).....	34.35	90.877	59.27	45.06	86.98	45.83	34.40	96.79	54.304
Iron (Fe_2O_3).....	0.126	32.12	5.311	.....	.....	.....	0.01	7.24	1.506
Lime (CaO).....	0.024	15.38	1.513	0.011	9.90	1.098	0.03	15.27	0.655
Magnesia (MgO).....	0.020	7.29	1.052	0.05	4.80	0.850	0.020	6.25	0.513
Alkalies:									
Potash (K_2O).....									
Soda (Na_2O).....	0.17	15.32	2.768	0.52	7.11	2.06	0.48	5.27	1.46

LIMESTONE.

The Preston area has an abundance of limestone adapted to the manufacture of commercial and agricultural lime, cement and road material. The ledges which attain sufficient development to be classed as commercial are the Elk Lick and Pine Creek limestones of the Conemaugh series; the Upper Freeport and Lower Freeport of the Allegheny; and the Greenbrier.

*Present Development.***Limestone Quarries.**

Elk Lick Limestone.—The Elk Lick is the only one of the above mentioned limestones that has not been quarried in Preston. A brief description of this ledge is given in Chapter VI, page 123, where it is shown that it attains its best development in the Kingwood Basin portion of Kingwood district. A sample for analysis was collected in this region at its crop along the west hillside of Cheat river, 0.5 mile west of Caddell station, where it is 4 feet thick, 9 feet below 11 inches of Elk Lick coal, and 95 feet above the Harlem coal with its overlying fossiliferous Ames shale (See section under description of coal of same name, page 123). The composition of the sample, as reported by Messrs. Hite and Krak, under Laboratory No. 773H, is as follows:

	Per cent.
Silica (SiO_2).....	5.78
Ferric Iron (Fe_2O_3).....	2.60
Alumina (Al_2O_3).....	4.32
Calcium Carbonate (CaCO_3).....	76.75
Magnesium Carbonate (MgCO_3).....	7.02
Phosphoric Acid (P_2O_5).....	0.17
Loss on ignition.....	3.74
Total	100.38

The above results reveal a fair limestone for agricultural lime, but too high in silica and alumina for most commercial uses. It is too limited in areal extent where it attains its best development to be considered of much value in view of more accessible areas of the great Greenbrier ledge within the county.

Upper and Lower Freeport Limestones.—Both these ledges have been quarried quite extensively by farmers of Grant and Pleasant districts to burn into agricultural lime which gives very satisfactory results. The thickness, composition, character and distribution of both the limestones have been discussed in Chapter VII, pages 155-9 and 165-9, respectively.

Greenbrier Limestone.—The Greenbrier limestone, described briefly in Chapter X, pages 186-7, has been quar-

ried both on a commercial scale and by farmers in Preston county. An account of these as also other exposures will now be given by districts.

An examination of Map II in **Grant district** shows two small areas of the Greenbrier limestone cropping therein; one, in the northwestern corner; and the other, in the southwest corner in the Cheat river gorge. In the former region it is quarried for local agricultural lime along the private road, 2.7 miles almost due west of Florence; where the following section was measured by Hennen:

	Ft.	In.
Concealed		
Shale, red.....	5	0
Limestone, blue and hard, many marine fossils..	50	0
Concealed by debris.....		
(Elevation of limestone, 2000' A. T., aneroid measurement).		

About a mile northeastward this stratum is quarried on the east hillside of Patterson run, according to Reger, on the land of H. A. Grim, where 108 feet of the ledge is exposed. Mr. Grim reports 8,000 bushels taken out during 1911, practically all of which was used for agricultural lime.

Its composition in this region is exhibited in the following analysis as taken from the report of W. B. Rogers¹ in 1839 and republished on page 344 of Volume III of the State Geological Reports, where the same was quarried as a flux for the Greenville furnace:

	Per cent.
Lime carbonate	88.32
Magnesium carbonate	
Alumina and iron.....	2.52
Silica	7.24
Moisture	0.72
Total	98.80

In the Cheat river gorge area of Grant district, only one small quarry for agricultural lime occurs on the Greenbrier, owing to lack of transportation facilities, although fine exposures of this limestone are found along the north hillside of Cheat, between Beaverhole and where it passes below the river, one-third mile below the mouth of Bull run. Its com-

¹Reprinted in Geology of the Virginias, p. 396; 1884.

position in this portion of Grant is probably about the same as that given for the ledge in Valley district along the south hillside of the same river, published in the table of analyses on a subsequent page.

In **Pleasant district**, the crop (See Map II) of the Greenbrier limestone is also confined to two small areas; one, in the southeastern corner around the nose of the Briery Mountain anticline; and the other, along the southwest edge in the gorge of Cheat river. In the former region this ledge has been quarried by farmers for local agricultural lime. Reger collected a sample for analysis and measured the following section at the **Abraham Wilhelm quarry**, located $\frac{1}{4}$ mile northwest of Cranesville:

	Ft.	In.
Soil, red		
Limestone, very hard, reddish gray, apparently both silicious and ferriferous.....	20	0
Concealed		
(Elevation of limestone, 2560' A. T., aneroid measurement).		

"Quarried into hill about 30 feet; quarry face, 30 feet long and 20 feet deep; several openings have been made; small grains of silica show on surface where ledge has been exposed to weather; dips to northwest at angle of 5 to 7 degrees; joint planes N. 14° E.; quarry apparently in upper portion of Greenbrier; no fossils observed."

The **composition** of the sample from the above quarry, as reported by Messrs. Hite and Krak, is given in the table of analyses below, under **Laboratory No. 769H**:

Table of Greenbrier Limestone Analyses—Preston County.

	Laboratory Number.						
	769H	770H	776H	S10H	S11H	S12H	S20Ha
Silica (SiO ₂).....	26.71	10.33	6.74	6.64	13.09	2.27	8.02
Ferric Iron (Fe ₂ O ₃).....	2.58	1.72	0.53	1.38	3.47	0.42	1.00
Alumina (Al ₂ O ₃).....	1.89	2.67	0.79	1.02	7.40	0.76	1.24
Calcium Carbonate (CaCO ₃).....	67.64	82.21	89.61	89.38	55.17	95.68	86.08
Magnesium Carbonate (MgCO ₃)..	1.28	2.03	1.61	1.76	15.73	1.07	3.27
Phosphoric Acid (P ₂ O ₅).....	0.12	0.12	0.07	0.06	0.10	0.12	0.17
Loss on ignition.....	0.	0.71	0.31	0.00	5.38	0.04	0.00
Totals.....	100.22	99.69	99.66	100.24	100.34	100.36	99.78

No. 769H—Abraham Wilhelm Quarry, $\frac{1}{4}$ mile N. W. of Cranesville, Pleasant district.

No. 770H—Andrew Feather Quarry, $1\frac{1}{2}$ miles N. W. of Cranesville, Pleasant district.

No. 776H—Terra Alta Lime Co. Quarry, 2 miles N. E. of Terra Alta, Portland district.

No. 810H—From Cheat River Gorge, $3\frac{1}{2}$ miles N. W. of Albright, and $\frac{3}{4}$ mile N. W. of mouth of Laurel run, Valley district.

No. 811H—From Cheat River Gorge, 3.3 miles northwest of Albright, and 0.4 mile northwest of mouth of Laurel run, Valley district.

No. 812H—From Cheat River Gorge, $1\frac{1}{2}$ miles southeast of mouth of Hackelbarney run, Valley district.

No. 820Ha—From Cheat River Gorge, 1.1 miles northwest of mouth of Hackelbarney run, Valley district.

In the same district, Reger collected another sample for analysis and obtained the following data at the **Andrew Feather quarry**, located on Muddy creek, 1.1 miles northwest of the summit of Piney Swamp knob:

	Ft.	In.
1. Soil, red.....		
2. Limestone, shaly.....	10	0
3. Limestone, good.....	15	0
4. Concealed		
(Elevation of limestone, 2315' A. T., aneroid measurement).		

"Bedding planes are very numerous, few of the layers being more than 1 foot thick, and some of them only 3 or 4 inches, separated by thin shale layers none of which is more than 1 inch thick. Dip is northwest, 3 to 4 degrees. Crinoids and brachiopods are very numerous, some of the crinoids being more than $\frac{1}{2}$ " in diameter. Quarry face extends parallel to a branch of Muddy creek for 500 feet including all the openings, and has been worked back into the hill about 30 feet. Limestone contains minute crystals of pyrites."

The **composition** of the sample from the above quarry is exhibited in the foregoing table of analyses, under **Laboratory No. 770H**. The limestone is quarried for agricultural purposes for which it is well adapted as shown by the analysis.

Owing to lack of transportation facilities, as in Grant, no quarries occur on the Greenbrier limestone in the Cheat River gorge portion of Pleasant district. Its composition in this locality is exhibited in the above table from samples collected on the opposite bank of the river in Valley district.

An examination of **Valley district** on Map II shows the crop of the Greenbrier limestone confined to two long narrow strips extending along the west hillside of Cheat river; one from a point 0.4 mile below the mouth of Laurel run northwestward to a point 1.1 miles southeast of the mouth of Big Sandy creek; and the other, from a point 1.6 miles southeast of Beaverhole southwestward to the Preston-Monongalia line. The same lack of transportation facilities has operated against the opening of quarries in both these areas, as in Grant and

Pleasant districts, although fine exposures of the ledge are found in both. In the former, Reger collected a composite sample of the upper 30 to 40 feet of the Greenbrier limestone with the exception of a sandy streak which was discarded, at an exposure, $\frac{3}{4}$ mile northwest of the mouth of Laurel run, the composition of which, as reported by Messrs. Hite and Krak, is given in the foregoing table of Greenbrier analyses, under **Laboratory No. 810H**.

Another sample was collected by Hennen on the same side of the river, near where the limestone emerges from the bed of Cheat, 0.4 mile northwest of the mouth of Laurel, from a ledge 10 feet in thickness, 25 feet below the top of the main bed, the composition of which, as reported by Messrs. Hite and Krak, is given under **Laboratory No. 811H**, in the foregoing table of Greenbrier analyses.

A short distance northwestward, Hennen collected another sample for analysis from 10 feet of the bottom portion of the ledge, where the base of the Greenbrier emerges from Cheat, the composition of which, as reported by Messrs. Hite and Krak, is given under **Laboratory No. 812H**. The results show this to be much the purest sample represented in the foregoing table of analyses.

Passing on down Cheat River gorge to the western slope of the Preston anticline, a sample for analysis was collected and the following section measured by Reger on the west bank, 1.1 miles northwest of the mouth of Hackelbarney run:

	Feet.
1. Sandstone, flaggy	
2. Concealed	25
3. Limestone, partly concealed.....	25
4. Sandstone, limy.....	10
5. Limestone, hard	5
6. Limestone, shaly	70
7. Limestone, hard	35
8. Shale, red	7
9. Limestone, hard, silicious.....	18
10. Sandstone, limy.....15'	} Pocono Sandstones
11. Sandstone, hard, to river 75'	
	90

The composition of the sample from only Nos. 5 and 7 of the above section, as reported by Messrs. Hite and Krak, is given under **Laboratory No. 820H(a)** in the foregoing table of Greenbrier analyses.

An examination of Map II will show that **Portland district** has a greater area of outcrop of the Greenbrier limestone than any other in the county. It is this ledge that is being quarried by the **Terra Alta Lime Company**, 2 miles northeast of Terra Alta, where a sample for analysis was collected and the following data jointly obtained by Hennen and Reger:

	Ft.	In.
1. Shale, red		
2. Sandstone	5	0
3. Limestone, gray and silicious.....	1	6
4. Limestone, dark gray and hard, quarry rock..	24	0
5. Limestone, reported, concealed.....	60	0

"Elevation of base of quarry, 2535' A. T., aneroid measurement; quarry face is 100 feet long and is worked back into the hill a distance of about 100 feet; dips east 10 to 16 degrees with the horizontal; bedding planes 4" to 2 feet apart; Sullivan Road Steam Rock Drill is used; lime is burnt in four circular kilns 24 feet in depth, each with a daily capacity of 100 bushels of lime; established in 1908; head office, Terra Alta, W. Va.; 8 to 10 men employed the year round, giving a monthly pay roll of \$300.00 to \$600.00; lime is ground and burnt by contract; lime is ground at the rate of 1¾ cents a bushel, the company furnishing drill and steam to run it and also all material for burning lime and pay contractor 2 cents a bushel for burning and drawing same; lime is packed in 125 lb. sacks and hauled over steel tram road in small cars to a connection with the Baltimore and Ohio railroad, and shipped as agricultural and building lime; M. L. Teets, Supt., and authority for data."

Along the western edge of the same district, the Greenbrier limestone is being quarried on an extensive scale near Manheim by the Alpha Portland Cement Company, a description of which and the plant will be given on a subsequent page.

In **Reno district**, the Greenbrier limestone has been quarried quite extensively for ballast along the main line of the Baltimore and Ohio railroad between Rowlesburg and Anderson, the details of which are exhibited in the section for the former place, page 97. No other quarries were noted, although good exposures occur southwestward along the eastern slope of Laurel Ridge.

In **Union district**, the crop (See Map II) of the Greenbrier is confined to two small areas or belts; one, crescent shaped, extending southwestward from the Portland-Union district line along the western slope of the Mt. Carmel Basin via the valley of the South branch of Snowy creek, Amboy, Carmel, Brookside and the valley of Rhine creek to an intersection with the



PLATE XXXVIII(a).—Showing Lower Falls of Big Sandy Creek, 1.3 miles northwest of Rockville, formed by Lower Connoquenesing Sandstone.



PLATE XXXVIII(b).—Showing rapids of Lower Falls of Big Sandy Creek, 2 miles NW. of Rockville.

W. Va.-Md. State line, 3 miles southwest of Crellin; and the other, a narrow band— $\frac{1}{4}$ mile wide—in the southeast corner of Union, extending along the east slope of Backbone Mountain. No quarries or exposures were observed in the latter region, but in the former several small prospects have been opened along the same near Aurora and Brookside to obtain limestone for agricultural purposes. The **David Selden quarry**, located on the east edge of the public road, $\frac{1}{2}$ mile northwest of Aurora, is on this ledge. The **Jacob Beachy lime kiln**, located $\frac{1}{4}$ mile due west of Aurora, established about 40 years ago and now abandoned, obtained its limestone from the Greenbrier in the immediate vicinity. This was a draw kiln, 20 to 25 feet high, and furnished agricultural lime for the immediate community.

Cement Mills.

In Volume III of the State Geological Survey, published in 1905, G. P. Grimsley gives an exhaustive account of the technology of the Portland cement industry and resources of West Virginia, at which time there was only one mill in the latter area, and it was located within the territory of this report. Since this is Preston county's greatest industrial plant, the very complete description of the same and other data incident thereto, as kindly furnished the Survey in a slightly modified form by Mr. G. S. Brown, 2nd Vice President of the operating company, is as follows:

Alpha Portland Cement Company.—This plant is located on the east hillside of Cheat river at Manheim, and previous to 1909 was owned and operated intermittently by the Buckhorn Portland Cement Company, a full account of which along with a description of the quarry, analyses of the limestone and a discussion of the character and quality of the cement is given by Grimsley on pages 492-499 of Vol. III of the State Geological Survey Reports.

Early in 1909 the plant was purchased by the Alpha Portland Cement Company of Easton, Pa., one of the largest manufacturers of Portland cement in the United States, having two large mills at Alpha, N. J.; two more at Martins Creek, Pa.; and one at Cementon near Catskill, N. Y., in addition to the Manheim, W. Va., mill. Since coming into its possession the

Manheim plant has been entirely remodeled with the exception of the Kiln Room, and has been in continuous operation since the latter part of 1909. It is now producing regularly over 1800 barrels per day of the highest grade of cement. Large quantities of the product of this mill have been used by the United States Government, various railroads, municipalities and large contractors—passing the most severe tests in all cases.

Quarry.—As originally designed it was intended to be operated as an open quarry. As the quarry face was carried back into the mountain side, it developed that the overburden of clay and shale which is useless in the manufacture of cement was so great as to make the cost of quarrying prohibitive. Consequently it was determined to mine the cement rock and a mine was started about the end of 1911. Early in 1912 the mine had been developed so that the entire requirements of the mill could be obtained from the mine. The height of the mine is about 27 feet, and the chambers are from 40 to 50 feet wide, the main gangway, being 30 feet wide. The stone is loaded in low cars holding two tons each. These cars are taken to the tippie by two seven ton gasoline locomotives. Drilling is done with tripod air drills, air being furnished from an electrically operated compressor in the power house. At the tippie the stone is dumped into the seven ton incline cars which are lowered down the plane to the chute above the crushers.

Stone House.—The stone chute delivers the stone to two No. 6 Gates Crushers, and from these by gravity is delivered to two 40-foot dryers of standard design, and by elevator from the dryers to a storage which contains sufficient stone to carry the mill over Sunday, thus eliminating all Sunday work in the mine and stone house.

Raw Preliminary Grinding Room.—In this room is contained two Kominuters and a pulverator which take the stone from the storage and prepare it for the fine grinding room. The stone from these Kominuters and pulverator is taken from a conveying belt and screw conveyors to bins over the fine raw grinding mills.

Fine Raw Grinding Room.—In this room are located nine 33" Lehigh Mills and one 42" Lehigh Mill which grind the stone to the fineness necessary for the kilns. The material

from these mills is taken by screw conveyors to the raw boxes back of the kilns.

Kiln Room.—In this room are six kilns, each 60' long, fired by natural gas which is piped from Lewis county, West Virginia. The resulting clinker is deposited in a storage over a tunnel through which runs a pan conveyor which delivers to the main clinker storage located along the hillside. The storage will hold 30,000 barrels and at the bottom is a tunnel through which the clinker is drawn from the storage and delivered by a pan conveyor elevator to the clinker storage above the Rolls.

Roll Room.—In this room are two Mosser rolls which prepare the clinker for the clinker fine grinding mills.

Clinker Fine Grinding Room.—Here are located nine 42" Lehigh Mills, four 30" Griffins and one Giant Griffin. This is ample grinding capacity for the output of the kilns and from these mills the cement is distributed to the stockhouses which will hold about 130,000 barrels of cement. Each stockhouse has its own packing house, well equipped, so that 4000 barrels can be packed and loaded on cars each 10-hour day.

Coal House.—Formerly the kilns were fired by pulverized coal and there is a well equipped coal house with coal dryer and three 33" Lehigh Mills with all necessary machinery to prepare sufficient coal for the kilns in 20 hours.

Power House.—The mill is operated electrically throughout. The boilers of which there are two 250 H. P. and three 150 H. P., are fired by natural gas. The electricity is generated by two 1000 K. W. Westinghouse turbo generators. The power house is well equipped with all modern accessories.

Machine Shop.—A well equipped machine shop is operated in connection with the mill.

With the exception of the old stockhouse and the machine shop all buildings are practically fireproof, being built entirely of stone, steel and concrete. At present plans are well in hand for the installation of a seventh kiln 100 feet long which will give the plant a capacity of 2500 barrels of cement daily.

Most of the employees live at Manheim where the company has erected some 20 or 25 modern cottages, each having a plot of ground for a garden. Seventy skilled and 100 un-

skilled men are employed daily. The pay roll averages \$12,000.00 monthly.

Available Limestone

A careful study of the foregoing data on the limestones in Preston and their analyses will readily show that the county's resources for limestone adapted to the manufacture of Portland cement, commercial and agricultural lime and road material are practically inexhaustible. The Greenbrier overshadows all the other limestones combined, and the composition of the samples from the same along Cheat River gorge, below Albright, exhibits the ledge similar in composition as at Manheim, and only lack of transportation facilities and favorable land for necessary buildings operate against the location along Cheat of other Portland cement mills on a scale as extensive as that last described.

The supply of Upper and Lower Freeport limestone is largely restricted to Lyon, Valley, Grant and Pleasant districts, and their economic value is local as compared to the great Greenbrier, their worth being largely governed by the demand for agricultural lime and road material in the immediate region of their outcrops.

There is no reason why the manufacture of lime on a commercial scale could not be made a profitable industry in the territory of this report, as the county holds, in addition to an almost unlimited supply of limestone, an immense tonnage of available coal of a character suitable to furnish the necessary fuel.

ROAD MATERIAL.

Limestone.

From the foregoing account of the limestones of Preston, it is quite evident that the county has an almost unlimited supply of this material for road surfacing, and the construction of concrete bridges across its numerous streams. The Greenbrier should constitute the main source of supply. For others that might be used for surfacing in the immediate region of

their crop, reference is here made to the Elk Lick, Upper Freeport and Lower Freeport, as these should stand weathering and abrasion fairly well, and convenience of quarrying in some parts of the county might operate in their favor as against the much better Greenbrier ledge.

Sandstone.

Preston county has an inexhaustible supply of sandstone that splits readily into blocks of almost any desired size for use in culverts or for foundations and abutments of bridges along the public highways, and for crushing into sand of the kind desired in stable concrete construction for road purposes. For sandstones that quarry well and at the same time possess durable qualities when exposed to the weather, reference is here made to the descriptions on preceding pages of the Morgantown, **Connellsville**, **Saltsburg**, **Buffalo** and **Mahoning** of the Conemaugh series; the **Lower Freeport** and **Clarion** of the Allegheny; the **Homewood** and **Upper Connoquenessing** of the Pottsville; and the **Rowlesburg** of the Chemung. Those in **black font type** should crush into sand with the right degree of sharpness and freedom from argillaceous material to form a strong bond in concrete work.

River and Creek Gravel.

There is probably a greater supply of gravel in the stream beds of Preston available for road material than in any of the counties of the State, the detailed geology of which has been published. This gravel is largely composed of the most durable portions of the hard sandstones over which the streams flow and for this reason will stand abrasion much longer than broken rock that is frequently applied to the road. It has also been worn down by attrition to a size suitable for direct application to the road surface, thus saving the additional expense of crushing, and when so placed is self-draining.

Brick for Road Pavement.

As already brought out in this chapter under "Clays", the amount of material suitable for the manufacture of paving brick is practically inexhaustible in the territory of this report. Brick paving for the country roads is rapidly forging to the front as the best means of preserving and maintaining our public highways in the face of the growing traffic thereon of self-propelled vehicles. This form combines comparatively cheap cost of construction with marked durability and several States—notably New York and Ohio—have recently completed many miles of brick paved country roads. Every magisterial district in the county carries large deposits of clay and shale suitable for paving brick as also an abundant supply of coal with which to burn the same, as can be readily ascertained from a perusal of the foregoing pages.

CHAPTER XIV.

BUILDING STONE, GLASS SAND, IRON ORE, WATER POWER, MINERAL WATER AND FORESTS.

BUILDING STONE.

The sandstones of Preston appear to be the only rocks that are adapted for building purposes, the limestones being too brittle in their nature to be successfully worked except for concealed work in foundations and chimneys. For sandstones that quarry readily into any desired forms and at the same time possess durable qualities in exposed structures, reference is here made to the descriptions on preceding pages for the Connellsville, Morgantown, Grafton, Saltsburg, Buffalo and Mahonings of the Conemaugh series; the **Lower Freeport** and Clarion of the Allegheny; the Homewood, **Upper Connoquenessing** and **Lower Connoquenessing** of the Pottsville; and the Rowlesburg of the Chemung. Those printed in **black font types** are frequently much current bedded and for that reason do not split evenly; hence, these are adapted for only very rough foundation work. It will readily be observed that the county has an inexhaustible supply of building stone, in fact Preston has one of the largest and most up to date quarries in the State, a description of which is given below.

Quarries.

Kingwood Quarries Company Quarry—Saltsburg Sandstone.

This quarry is on the Saltsburg sandstone and is located one mile almost due north of the M. & K. R. R. station at Kingwood. According to information given Hennen by J. H. Knowlton, President and General Manager, the quarry was

first established in 1908 by Zevely and Casto to get out stone for piers in the bridge across the Monongahela river at Monongahela City, Pa., and worked for 3 years for bridge and curb stone. The quarry rock is what is known to the building trade as a semi-quartzite, being composed largely of silica mottled with specks of iron apparently completely oxidized since it does not stain or discolor in exposed structures. Its durability is well exhibited in the old chimney on the Alpheus Carroll farm, which was constructed of stone from this quarry over 100 years ago and is still in fine condition, the pick marks thereon showing very distinctly. Here it has weathered to a beautiful mellow yellowish color. The capacity of the quarry is 1,000 to 1,500 cubic feet daily (10-hour day). That the stone is rapidly gaining a reputation for beauty, durability and fire-proofness is demonstrated by its use in New York City in the construction of the Russell Sage Memorial Building, and the Synod House of the Cathedral of St. John the Divine, the largest in America. It was also used in interior finishing in the new Jersey City Post-Office Building, New Jersey; and for the exterior base, steps, etc., of the new Federal buildings now being erected in this State at Morgantown, Grafton, and Sistersville. It takes a fine polish, making it very attractive for interior decoration.

Mill.—The rough stone was formerly shipped in large blocks, weighing from 12 to 15 tons each, to a mill in New York City, where it was cut and dressed for both interior and exterior finishing. During the latter part of 1912 and the first part of 1913, a special mill for this purpose was erected at the quarries by the same company, the capacity of which is about 200 cubic feet of cut rock daily. The equipment consists of two Lincoln Iron Works gang saws with parallel motion; one overhead crane; one air compressor; planes; cutting sheds; three 100-horse power boilers; and one 125-horse power engine; or practically everything necessary to fill any kind of a cut stone order.

Quarry.—The quarry face will average about 20 feet high, the ledge being massive, quite homogeneous, resting on clay and belonging, according to the log of a core test boring starting near the base of the stratum, 55 feet above the Bakerstown coal and 250 feet above the Upper Freeport coal. It is evident



PLATE XXXIX(a). Showing Cascade Falls of Deckers Creek along the M. & K. Ry., formed by one of the Pottsville sandstones.



PLATE XXXIX(b).—Showing typical Pottsville topography forest conditions originally along the M. & K. R. R., formed by one of the Pottsville Sandstones

that the quarry rock is an upper division of the Saltsburg sandstone. The ledge is roughly exposed at crop for about three-fourths mile, along which three quarries are already opened, the working faces ranging from 200 to 600 feet in length. The quarry equipment consists of 6 steam hoists and 4 steam drills. Including the mill, employment is furnished for 60 men, 40 of whom are skilled cutters, and the others, laborers in quarry, the monthly pay roll amounting to about \$5000.00 when working at full capacity.

Chemical Composition.—The composition of a sample collected by Hennen from the main ledge, as reported by Messrs. Hite and Krak, is given below under **Laboratory No. 796H**, and also another analysis—the average of two samples, furnished by Mr. Knowlton—as determined by R. W. Hunt & Co. of New York City:

	Lab. No.	R. W. Hunt
	796H	& Co.
Silica (SiO_2).....	96.50	93.82
Ferric Iron (Fe_2O_3).....	1.76	1.98
Alumina (Al_2O_3)	0.86	2.67
Lime (CaO)	0.35	.....
Magnesia (MgO)	0.02	.....
Loss on ignition.....	0.63	.....
Totals	100.12	98.47

The above results account for the durable qualities possessed by this stone, since it carries only very small amounts of alumina, lime and magnesia. The Survey sample shows up even better than the analysis furnished by the President of the Company.

Physical Tests.—No physical tests were made on the stone from this quarry, but the following letter furnished by Mr. Knowlton, from a reputable engineering firm of New York City, gives valuable information concerning its worth:

"New York, April 17, 1913.

"Kingwood Quarries Co., Fifth Ave. Bldg., New York City, N. Y.

"Gentlemen:—We give you below results of tests of two cubes of sandstone which you submitted.

Cube	No. 1	No. 2
Width in inches.....	4	4
Length in inches.....	4	4
Height in inches.....	4	4
First crack, in pounds.....	133,050	127,600
Ultimate strength, in pounds.....	179,100	148,080
Ultimate strength per sq. in.....	11,194	9,130
Weight per cubic foot, pounds.....	146	146
Per cent. absorption.....	3.25	3.35
Per cent. iron, calculated as oxide.....	1.50	1.33

"Samples from each cube were heated to 1600° F. for one-half hour. The samples softened so that sand could be rubbed off, but did not disintegrate.

"We are unable to see any pyrite and are of the opinion that the sample will not show any signs of rusting or further weathering.

"Respectfully,

(Signed)

R. W. HUNT & CO."

The ledge has a very shallow cover of debris and shale over quite a large area, under which seven core test borings have demonstrated its continuity in practically the same character as at the present quarry faces. Hence, there appears to be about 40,000,000 cubic feet of stone available at this point, according to Mr. Knowlton, sufficient to keep the plant running even with an anticipated greater capacity for 25 to 30 years.

The rough quarried blocks sell at 60 cents a cubic foot at the plant and the cut stone averages \$2.00 a cubic foot.

Gocella Quarry—Saltsburg Sandstone.

The Saltsburg sandstone was once quarried quite extensively along the west hillside of Cheat river, $\frac{1}{2}$ mile south of Albright, at an elevation of 1390' A. T., aneroid measurement, as determined by Hennen. This had been abandoned before 1912. On page 483 of Volume IV of the State Geological Survey Reports, G. P. Grimsley gives the following account of this quarry previous to June 15, 1909:

"Mr. C. A. Gocella, of Falls Creek, Pa., opened a sandstone quarry in the summer of 1907 at Albright, a station on the Morgantown and Kingwood railroad three miles west of Kingwood. The stone was used on the abutments of the new B. & O. bridge near Rowlesburg, and has been shipped to other points for building stone. A quarry in the same sandstone was opened by Zevely and Casto one mile west of Kingwood, and the rock from this quarry is used mainly for curbing at Morgantown.

"Some of the stone is gray to white in color and fine grained in texture. Other portions are mottled with brown iron spots, and some ledges are yellow to light brown in color, dotted with iron spots. Various colors are to be found, but the main rock is the mottled gray or brown rock. In 1907, 36 to 40 men were employed and five cars loaded daily.

"The quarry is near the center of the large syncline and the Upper Freeport coal goes under Cheat river three-fourths mile west at a level of 216 feet below the quarry. The Bakerstown coal was formerly mined on a small scale on the Kingwood pike at a level 30 to 40 feet below the base of this sandstone, and it therefore represents the Saltsburg sandstone.

"Quarry.—The quarry is worked with a face 300 feet long and back 15 to 20 feet. The base of the rock is not reached, and the blocks which have rolled down the hill are also worked. The stone is in two ledges:

	Feet.
"Cover	1
Sandstone ledge.....	8
Sandstone ledge.....	10

"The joint planes run N. 50° W. and N. 20° E., with a few N. 5° E."

John F. Stoer Quarry—In a Mauch Chunk Sandstone.

There are several sandstones near the base of the Mauch Chunk series of Preston county that should make fair building stone. The following detailed description by G. P. Grimsley of the Stoer quarry in one of these ledges is given on pages 524-526 of Volume IV of the State Survey Reports:

"On the lands of John F. Stoer, of Philadelphia, located two miles below Manheim or five miles from Rowlesburg, down the Cheat river, a blue and buff sandstone has been quarried at the side of the Morgantown and Kingwood railroad. The stone was used in the construction of the buildings for the Buckhorn Portland Cement Company plant at Manheim, and was then abandoned.

"The sandstone comes in the shales above the Greenbrier limestone and 500 feet below the Pottsville conglomerate. It therefore belongs in the Mauch Chunk formation. The stone is blue and buff, or locally called gray in color. It is a very hard, compact rock, but breaks readily parallel to the bed with smooth planes coated with glistening mica flakes. The blue or gray rock often has a greenish tinge, and is so fine grained that with a lens the quartz grains can

not be distinguished. Some of the courses, especially in the blue ledges, are flaggy.

"Quarry.—The floor of the quarry is 18 feet above the M. & K. railroad. The face runs northeast-southwest, and it was worked to the east. The main joint plane determines the direction of the quarry face and runs N. 30° E. A section of the quarry shows:

	Ft.	In.
Chocolate brown shales.....	8	
Buff shaly sandstone.....	10	
Buff flag sandstone.....	12	
Blue shale	1	
Blue sandstone, flaggy.....	1	6
Buff and some blue sandstone.....	10	

"From the bottom of the quarry to the railroad track, the sandstone is quite flaggy on outcrop and blue in color. While most of this stone now exposed is a buff or brownish color, it is very probable that as the stone is followed into the hill, it will become blue in color. The flaggy character of some of the ledges will probably change and the rock become more solid. The stone dips strongly to the north and passes under the river in a short distance.

"The main joint planes run N. 30° E., and while there are some small cracks at right angles to these planes or nearly so, there are no well defined joint planes visible.

"Microscopical Structure.—Mr. S. L. Powell makes the following report on a thin section of the buff or brownish sandstone from the Stoer quarry:

"The section shows the rock to be a finely granular sandstone, originally composed of grains of quartz, feldspar, mica, kaolin, and other ferro-magnesian minerals, with a few zircons. Many of the quartz grains were originally well rounded, but now all are more or less angular, due to secondary enlargement by silica which forms part of the cement. The greater portion of the interstitial matter, however, is due to the development of secondary minerals, such as chlorite, muscovite, kaolin, and calcite, which originated from the alteration of the feldspars, mica, and other ferro-magnesian constituents.

"A considerable amount of the ferric iron has also developed which gives color to the rock, and forms part of the cement. This intricately intergrown secondary mineral matter is very abundant and forms the matrix or ground mass for the quartz grains and remaining feldspars. The average diameter of the grains is about 0.25 millimeter."

"The greenish blue, or locally called gray, sandstone from this quarry was also examined in thin section, by Mr. S. L. Powell, who makes the following report:

"This rock is finely granular, the grains varying from minute particles to 0.4 millimeter in diameter. The shape of the grain is very irregular, varying from a few rounded individuals, to jagged, frayed, triangular and elongated forms. But few interstices between the grains remain unfilled, and the rock is, therefore, very compact and almost non-porous.

"Quartz is the most abundant mineral present, next in amount are a few feldspars, and occasionally an altered biotite. Flakes of kaolin are abundant. The only change in the quartz is that due to enlargement by secondary silica, extending the grains until in many instances they completely interlock in the formation of larger quartz

areas. In addition there are other independent areas of secondary silica filling the interspaces.

"A few plagioclase feldspars remain practically unaltered and show characteristic twinning. The greater portion of the feldspar is either much altered or completely broken down into aggregates of secondary minerals. muscovite, chlorite, calcite, and quartz, which completely fill the interstices between the grains. In some cases instead of a mosaic of these minerals, there is a considerable development of sericite or chlorite, as if from a course other than feldspar, probably some original ferro-magnesian constituent. These secondary minerals together with the silica constitute the cement which forms a very resistant bonding material. The color of the rock is due to the large development of secondary minerals, chlorite, especially, which gives the greenish tinge to the rock."

Stone from the Stoer quarry was sent to the testing laboratory of the U. S. Geological Survey at St. Louis, Mo., for physical tests, the complete details of which, as published on pages 567-568 of Volume IV of the West Virginia Geological Survey Reports, are as follows:

"Compression Test.

Lateral Dimensions Inches.	Height Inches.	Ultimate Strength Pounds.	Modulus of Elasticity.
4.06 x 4.11	3.91	.....	1,950,000
4.14 x 4.03	4.00	.....	1,400,000
4.16 x 4.13	4.00	.....	1,980,000
Average			1,780,000

"Transverse Test.

Breadth. Inches.	Depth. Inches.	Span. Inches.	Modulus of Rupture. Pounds.
6.09	4.05	20	2,130
6.08	4.06	20	2,300
Average			2,220

"Ratio of Absorption.

	Weight.			Volume.		
	30 min.	24 hours.	48 hours.	30 min.	24 hours.	48 hours.
	0.25	1.33	1.63	0.62	3.38	4.14
	0.21	1.12	1.40	0.53	2.85	3.56
	0.24	1.37	1.68	0.61	3.48	4.26
Average	0.23	1.27	1.57	0.59	3.24	3.99

"Shearing Test.

Lateral Dimensions.	Loaded Length.	Ultimate Strength.
Inches.	Inches.	Pounds.
2.20 x 2.21	2	1,590
2.23 x 2.19	2	2,610
2.14 x 2.16	2	2,420
Average		2,310

Apparent specific gravity.....2.538
 Weight per cubic foot.....158.2 lbs."

Only one quarry on the sandstones of the Catskill series of Preston county was noted, concerning which Grimsley gives the following on page 527 of Volume IV last mentioned:

"A very durable brown sandstone outcrops high in the hills opposite Rowlesburg in Preston county, and apparently corresponds in position to the Catskill. It has been opened as a quarry prospect by Mr. John F. Stoer, and shows a good ledge of rather fine grained brown sandstone which would doubtless prove to be a very popular trimming stone."

**Preston Blue Stone Company Quarry—Rowlesburg
Sandstone.**

The Rowlesburg sandstone, belonging near the middle of the Chemung rocks of Preston (See Rowlesburg section, page 97), has been quarried on quite an extensive scale at the town of the same name. A very complete account of this quarry by Grimsley, published on pages 527-529 of Volume IV, is given herewith as follows:

"Rowlesburg in Preston county is 26 miles east of Grafton on the main line of the Baltimore and Ohio railroad. It is also reached by the Morgantown and Kingwood railroad. At this place on the east bank of Cheat river and near the B. & O. railroad bridge, Mr. H. W. Rightmire operates a sandstone quarry under the name of the Preston Blue Stone Company.

"The floor of the quarry is below the level of the railroad, about 15 feet above Cheat river. The hill back of the quarry rises 800 to 900 feet higher, but does not reach the Greenbrier limestone. The sandstone comes in the Upper Devonian, probably at the Chemung-Catskill horizon. The rock varies in color from a gray or slate color to a green or greenish blue. It is close grained and very hard, with white mica flakes and very small quartz grains. It does not show a distinct banding except in a few places, but splits readily parallel to the bed planes, so that while very hard, it is readily worked. The stone can be broken into flags, and the upper courses are so used.

Some of the bedding planes are polished smooth, almost slicken-sided. The overlying shales are ripple marked.

"The color is uniform and durable, and this quarry furnishes one of the most attractive trimming stones in the state, and it is shipped to many eastern cities. It was used in the trimmings of the Johns Hopkins University at Baltimore and in some of the bank buildings in that city. In one of these bank buildings near the center of the Baltimore fire district, the stone passed through that great conflagration with but little injury. It is now shipped in carload lots to Philadelphia and New York. The quarry was first opened nearly 60 years ago.

"**Quarry.**—The face of the quarry runs north and south, 350 feet long, and it is worked to the east. The stone is loosened from the wall by light shots and then broken into blocks by use of plugs and feathers to avoid any injury to the strength of the stone. The stone dips to the north about 1 foot in 25 in places. A section at the north end of the quarry not worked at the present time shows:

	Ft.	In.
Soil cover.....	3	
Shaly sandstone.....	4	
Shales	2	
Sandstone	2	6
Blue shales with sandy layers.....	10 to 12	
Blue to black shale.....	1	6
Greenish blue sandstone ledge.....	3	
Greenish blue sandstone ledge.....	8	

"At the south end of the quarry which is now being worked, the following ledges are exposed:

	Ft.	In.
Course sandy shales.....	8	
Blue laminated shales.....	12	
Buff sandstone.....	4	
Blue shales	2	
Bluish gray sandstone, irregular.....	3	6
Drab to gray sandstone.....	1	6
Shale	0	0½
Greenish blue to gray sandstone.....	0	6
Shale	0	1
Greenish blue to gray sandstone.....	0	6
Shale	0	1
Shaly sandstone	0	6
Shales, blue and buff.....	3	
Buff or brown sandstone.....	4	
Greenish blue, foliated sandstone.....	5	
Greenish blue and buff sandstone.....	5	

"The lower 14 feet represent the working part of the quarry and especially the lower 10 feet. The bottom course of two feet is often left in the quarry on account of its darker color. The joint planes run N. 10° E., and due east and west. The physical tests on this sandstone are given in Chapter XXVI.

"**Microscopical Structure.**—A thin section of the Rowlesburg sandstone was examined by Mr. S. L. Powell, who makes the following report:

"This is a very fine grained, homogenous, compact sandstone, composed of angular quartz grains, fresh feldspars both orthoclase and plagioclase showing the characteristic twinning, also flakes of mica both muscovite and biotite, iron oxide, and kaolin.

"The cement is abundant and pores few in number. In character the cement is a mixture of minerals resulting from the decomposition of feldspar, mica, and other original mineral constituents such as chlorite, muscovite, calcite, epidote, silica, and iron oxide. These minerals are completely intergrown, firmly uniting the whole into a hard compact rock. The dark green or bluish gray color of the rock is due to the abundance of chlorite and oxide of iron blending with the lighter colored minerals."

Samples of this stone were also sent to the testing laboratory of the U. S. Geological Survey at St. Louis for physical tests, the complete details of which, as published on pages 569-570 of Volume IV, are as follows:

"Transverse Test.

Breadth. Inches.	Depth. Inches.	Span. Inches.	Modulus of Rupture. Pounds.
6.00	4.17	20	2,345
6.10	4.18	20	2,599
6.15	4.21	20	2,541
Average			2,495

"Ratio of Absorption.

Weight.			Volume.		
30 min.	24 hours.	48 hours.	30 min.	24 hours.	48 hours.
0.24	1.31	1.52	0.62	3.36	3.90
0.26	1.26	1.47	0.68	3.24	3.77
0.42	1.92	2.04	1.07	4.85	5.16
Average	0.34	1.50	0.79	3.82	4.28

"Apparent specific gravity.....2.557

"Weight per cubic foot.....159.4 lbs."

The foregoing data on building stone in Preston show this area in the front rank among the counties of the State.

GLASS SAND.

Quarries.

The manufacture of glass sand is one of the important industries of the county, owing to Preston's proximity to the great natural gas fields and associated glass plants in the



PLATE XXXX.—Timber slashings in left foreground and topography of the Chemung rocks, looking up Bear Run of Horseshoe Run.

Photo by E. E. Knight

western counties of the State. At present there are only two quarries devoted to the same; one on the Clarion sandstone of the Allegheny series, or the Homewood of the Pottsville; and the other, on the Upper Connoquenessing ledge of the Pottsville measures. These will now be described in the descending order of the rocks quarried:

Warfield Sand & Stone Company—Clarion Sandstone.

The offices of the Warfield Sand & Stone Company are in Morgantown, W. Va., according to data collected by Reger, and the plant is located on a short branch line of the Baltimore & Ohio railroad, along the east bank of Threefork creek, $1\frac{1}{4}$ miles due north of Hardman. The plant was established during 1908 by J. H. Irving under the name of The Irvington Mineral Company, and passed to the present owners in 1911. It has a capacity of 800 to 900 tons of glass sand monthly, furnishing employment for 20 men.

The sandstone is pulverized in a McLaren Rock Crusher. The quarry face is about 400 feet long and extends into the hill about 100 feet, requiring very little stripping to expose the same. The ledge is soft, white, smooth grained, micaceous, with no pebbles, and with numerous horizontal bedding planes as also diagonal joint planes running at angles of 45 degrees with the vertical. The quarry rock has a thickness of about 40 feet, belonging from 1 to 8 feet below the Lower Kittanning coal—6 feet thick—and immediately over another coal (Clarion), its relative position in the rock column in this portion of Lyon district being exhibited in the Newburg section and the log of Bore Hole No. 63, pages 89 and 240, respectively.

Chemical Composition.—Reger collected separate samples of the sandstone and of the prepared sand from a stock pile, the composition of which, as reported by Messrs. Hite and Krak, is given below under Laboratory Nos. 589H and 590H, respectively:

	589H	590H
Silica (SiO_2).....	99.80	99.78
Ferric Iron (Fe_2O_3) and Alumina (Al_2O_3)	0.24	0.16
Totals	100.04	99.94

The above results show an extraordinarily pure sand which should be adapted to the manufacture of the finest flint ware where great brilliancy and uniform density are required. At present the entire output is shipped to window glass factories in Clarksburg, Grafton, West Union, and Weston.

White Rock Sand Company—Upper Connoquenessing Sandstone.

The offices of the White Rock Sand Company are located at Fairmont, West Virginia, and the plant on the main line of the Baltimore and Ohio railroad at Holmes, 1 mile northwest of Corinth. Only glass sand and sand for cement purposes are manufactured. It was started in November, 1906, and doubled in size near the close of 1907. Grimsley gives the following detailed account of the plant and quarry, and the composition of the sand on pages 387-388 of Volume IV of the West Virginia Geological Survey Reports:

"The sandstone is crushed in a Jeffrey pulverizer then in an 8-foot wet pan. It is washed by three conveyors and passes through a circular screen with 16 mesh and seven feet in diameter, and dried in a steam drier. Water for washing is supplied by Snowy Creek and also two smaller streams, Spring and Philadelphia runs. The capacity of the plant is 200 tons daily, and pure white sand is sold as glass sand, and the slightly colored sand is shipped for building sand.

"The quarry is located back of the mill and connected by an incline track. The sandstone is 60 to 80 feet thick but much of it is too impure for glass sand. The working quarry is 22 feet high and worked in a northeast direction, the stone dipping to the southeast. At the bottom of the quarry is a 3-foot stratum of very coarse sand filled with clear translucent flint pebbles; above this layer come 4 feet of coarse sand, then 2 feet of finer gray to white sand, and above this 3 feet of pink colored sand, overlaid by 4 feet of pink and white sand. The work last year was mainly on outcrop material which was sold as building sand, but a better grade of sand was found farther in the hill, also above the top of the present quarry.

"The selected sand from this plant has the following composition according to the Survey analyses:

	Per cent.	Per cent.
Silica	98.20	98.95
Iron oxide	0.0295	0.048
Alumina	1.5705	1.112

"The following Survey analyses show the composition of the pink sand and the No. 2 glass sand:

	Pink sand	No. 2 sand
Silica	97.10	98.60
Iron oxide	0.0457	0.045
Alumina	2.7743	1.465

"The rock is friable and readily broken and forms a uniform angular sand which has been successfully used at a number of glass plants."

The quarry rock correlates with the Upper Connoquenessing and not the Homewood as has been published in State Reports heretofore. The following section was measured by Hennen at the quarry face:

	Ft.	In.
Sandstone, massive, white, pebbly at bottom.....	19	0
Coal streak 0" to.....	0	1
Sandstone, massive, white, pebbly to base of quarry	15	0

The composition of a sample collected from 15 feet of the top portion of the Upper ledge, as reported by Messrs. Hite and Krak, under Laboratory No. 775H, is as follows:

	Per cent.
Silica (SiO_2).....	99.48
Ferric Iron (Fe_2O_3).....	0.10
Alumina (Al_2O_3).....	0.07
Lime (CaO)	0.01
Magnesia (MgO)	0.02
Loss on ignition	0.20
Total	99.88

The analysis shows even better than that given on a preceding page as sampled by Grimsley. Most of the output of glass sand is shipped to the Hazel-Atlas Glass Company at Clarksburg, W. Va., and Washington, Pa., bringing \$1.00 a ton at the plant, and the gravel and pebble screenings, 90 cents a ton for concrete work, according to Mr. G. M. Lewis, Foreman of the plant.

Available Sand.

There appears to be an inexhaustible quantity of sandstone in Preston county adapted to the manufacture of glass sand. Only the Clarion and Upper Connoquenessing, as will appear from the foregoing data, have as yet been worked on a commercial scale. Their outcrops may be closely determined

wherever they occur in the area, as they should follow closely the division line between the Allegheny and Pottsville series as outlined in detail on Map II. There should be many other favorable localities where the latter stratum could be worked with profit when proper transportation facilities have been provided.

In the eastern edge of Union district, Reger collected a sample of what appears to be the Upper Connoquenessing ledge at what he considered a fine prospect for glass sand on the land of the Kendall Lumber Company at the summit of the old abandoned lumber railroad grade on the northwest side of Shaffer Mountain, 2.5 miles northeast of Aurora, at an elevation of 2880' A. T., aneroid measurement, the composition of which, as reported by Messrs. Hite and Krak under Laboratory No. 808H, is as follows:

	Per cent.
Silica (SiO_2)	97.76
Ferrie Iron (Fe_2O_3)	0.19
Alumina (Al_2O_3)	1.48
Lime (CaO)	0.02
Magnesia (MgO)	0.05
Loss on ignition	0.52
Total	100.02

The percentage of impurities is practically the same as that given above for the same ledge at the Holmes quarry of the White Rock Sand Co., 6 miles northward. Reger reports the top portion soft and almost free from pebbles, the cementing material being silica. Rails could readily be relaid on the grade of the above mentioned lumber railroad (abandoned) crossing here, thus furnishing an easy means of transportation. The lack of cover makes the stone easy to quarry.

It is quite probable that the Lower Freeport sandstone would crush into a fair quality of glass sand at many of its exposures in Preston county. However, it is generally quite hard, and the additional expense required to pulverize the same as compared to the softer ledges described above, might operate against this stratum. In the western edge of Lyon district, Reger collected a sample of the Lower Freeport sandstone at Orr's Mill near Irondale, where a thickness of 25 feet is exposed, the composition of which, as reported by Messrs. Hite and Krak under Laboratory No. 762H, is as follows:

	Per cent.
Silica (SiO_2)	98.84
Ferric Iron (Fe_2O_3)	0.13
Alumina (Al_2O_3)	0.71
Lime (CaO)	0.06
Magnesia (MgO)	0.03
Loss on ignition	0.17
Total	99.94

The results speak for its freedom from impurities in the way of iron and alumina. The areal extent of the crop of this sandstone should follow closely the same regions outlined for the Upper Kittanning coal on Map II. The stratum has already been described in Chapter VII, pages 169-170.

IRON ORE.

Old Furnaces.

The development of the iron ores of Preston county ceased in the early 80's of the last century on the opening up of the great stores of the rich hematite ores in the Great Lakes region. Previous to this time, there were five furnaces within the county; viz, Greenville, Valley, Josephine, Irondale or Franklin, and Gladesville. Their descriptions follow herewith:

Greenville Furnace.—Greenville furnace was located on Laurel run, 1.5 miles north of Laurel Church, Grant district, concerning which Wiley¹ gives the following:

"Greenville Furnace is four miles from Bruceton; was started, it is said, by Walter, commonly called 'Wat' Carlile, on a barrel of watered whiskey, a box of home-made tobacco, and a 10-dollar counterfeit note. He built the furnace about 1815, but having no capital, he could not run it. It passed into the hands of Miller & Frantz, and then to Fay, who failed. Next and last a Boston company, in 1836, with Harrison Hagans as president, ran it a short time. It is now torn down. (1882)."

Valley Furnace.—This furnace, a photograph of which appears in this report, is located in the northwestern corner of Grant district on Patterson run at the cross-roads, 0.4 mile south of W. Va.-Penna. State line. It is still in a fair state of

¹S. T. Wiley, History of Preston County, pp. 25-26; 1882.

preservation as the picture shows. On page 376 of the last citation quoted, Wiley gives the following:

"Valley Furnace was built about 1837, by Andrew Ochiltree, and James Caldwell operated it between two and three years. Both these furnaces (referring to Greenville) had ores sufficient, but long transportation and want of capital caused them to go down. Valley still stands."

The following account of the Josephine, Irondale and Gladesville furnaces is taken from pages 113-114 of Volume IV of the State Survey Reports:

"Josephine Furnace was built on Muddy Creek, in Pleasant district, in 1852-3 by Harrison Hagans and called Virginia Furnace, and it was quite successful after the war. It was operated by George Maust, then by Lloyd and later by Landon. In 1879 it was run by S. B. Patterson under the name of Josephine Furnace, and work ceased in 1880. In Valley district, Scott and Dougherty, about 1825, started the erection of a furnace at Deckers creek Falls, two miles from Masontown, but it apparently was never completed.

"Irondale or Franklin Furnace, in Lyon district, two and a half miles from Independence, was built about 1859 by George Hardman and was known as Hardman furnace. He ran it until 1865, when the Franklin Iron and Coal Co. came in possession and named it Franklin Furnace. In 1866 Hardman again ran it and in 1877 it was bought by Col. F. Nemegyei, who made extensive repairs.

"On April 15, 1878, the first metal was made under the superintendence of Alex. Strausz and A. Evans. In the fall of 1878. Wm. Tate remodeled the furnace, increasing its capacity from 10 to 30 tons of iron in twenty-four hours. The blast was put in during June, 1879, and ran to July, 1880, when the furnace was repaired and ran until June, 1881, when work was stopped on account of a strike of the laborers. Some repairs were made and blast started in October, 1881, and ran to 1882.

"The furnace was 62 feet high, with 14-foot bosh, and made a cold-short pig iron for foundry use. Carbonate ores were used known as rock and shell ore with metallic iron reported as 37 and 50 per cent. There were 25 or 30 coke ovens supplying coke for the furnace and the power was furnished by a 150 H. P. engine.

"Gladesville Furnace, was built about 1870 by George Hardman and sold to Calhoun and Evans, who were followed by Tate and Laferty in 1879, who operated it until 1881, since which time it has been idle."

Josephine furnace was located in the southwest edge of Pleasant district, on the east bank of Muddy creek, 1.4 miles due west of Hayden, the Irondale, in Lyon district, at Irondale; and the Gladesville, in the northern portion of the same district, on the south side of Gladesville.

As appears in their descriptions, these furnaces were all abandoned more than 30 years ago.

Available Ore.

In Preston county the available iron ores are to be found in the Conemaugh, Allegheny, Pottsville and Mauch Chunk rocks. They consist mostly of lean carbonates that can not compete at present with the rich hematites of Minnesota and Michigan. When visited during 1912, all the old prospects that had formerly supplied the above furnaces with ore had fallen shut so that it was not possible to ascertain directly their thickness and character. However, Dr. Wm. B. Rogers made an exhaustive study of the ores at the numerous openings along the crest of the Chestnut Ridge anticline on the western edge of Preston while they were being worked in 1854, and the results of his investigations are largely republished by Grimsley on pages 115-124 of Volume IV of the State Survey Reports.

The several ore horizons in the county will now be discussed by series in descending order:

Iron Ore of the Conemaugh Series.

Johnstown Iron Ore.—The only horizon of the Conemaugh of Preston that appears iron bearing is the ferriferous shale, known as the Johnstown ore and belonging 10 to 30 feet below the Brush Creek coal. In the northeastern corner of Lyon district, about 30 feet of these ferriferous shales are exposed along the bed of Stony run, $\frac{1}{2}$ mile southwest of Browns Mills, as exhibited in the section given on page 144 under the description of the Brush Creek limestone. No sample was collected for analysis, but the ore should carry here about the same percentage of metallic iron as in the Little Falls region of the Monongahela river, its composition at the latter point being published on page 767 of the Monongalia-Marion-Taylor Report.

At several other exposures of the same horizon, no iron was noted; hence, it is quite irregular in its deposition.

Iron Ore of the Allegheny Series.

Irondale Ore.—In western Preston there is a large amount of an iron carbonate ore belonging from 5 to 30 feet

below the Upper Freeport coal, being intimately associated with and sometimes replacing the Upper Freeport limestone. It was mined quite extensively to furnish ore for the old furnace that was located at Irondale in the western edge of Lyon district, from which place it was designated the "Irondale Ore" by I. C. White, concerning the character of which he has the following to say on page 272 of Volume II of the State Survey Reports:

" * * * * * The limestone* is of fair quality but not of marine origin, and was used as a flux at the Irondale furnace. The iron ore is a carbonate but rather lean, having only 35 per cent. of metallic iron, and 12 to 15 per cent. of silicious matter. It was mined by stripping at Gladesville, and at Irondale by both stripping and drifting, the limestone above being taken out for flux, and thus making room to get the ore. The latter was roasted before mixing with 'Lake' ores for use in the furnaces. The ore is too lean for successful iron manufacture, and the furnace has been out of blast for twenty years. (1903)."

A sample for analysis was collected and the following section measured with hand-level by Hennen at one of the old drift openings in the Irondale ore, located on the east edge of the public road, 0.2 mile southeast of Irondale:

	Ft.	In.
1. Concealed		
2. Sandstone, massive	15	0
3. Shale sandy	5	0
4. Limestone, gray and hard, Upper Freeport...	6	0
5. Shale, dark, gray.....	0	6
6. Limestone, ferriferous, "Irondale Ore".....	2	9
7. Shale, gray, and concealed.....	67	0
8. Coal, Upper Kittanning, concealed, opening fallen shut, reported.....	4	0
Elevation of ore, 1320' A. T., aneroid measurement.		

The composition of a sample of the limestone from No. 4 of section, as reported by Messrs. Hite and Krak under Laboratory No. 577H, is given on page 159, under the description of the Upper Freeport ledge. The composition of the ore—No. 6 of section—as reported by the same chemists under Laboratory No. 578H, is as follows:

	Per cent.
Silica (SiO_2)	3.60
Metallic Iron	32.88
Lime (CaO)	13.83
Sulphur	0.73
Phosphorus	1.99

*Upper Freeport limestone.—R. V. H. & D. B. R.

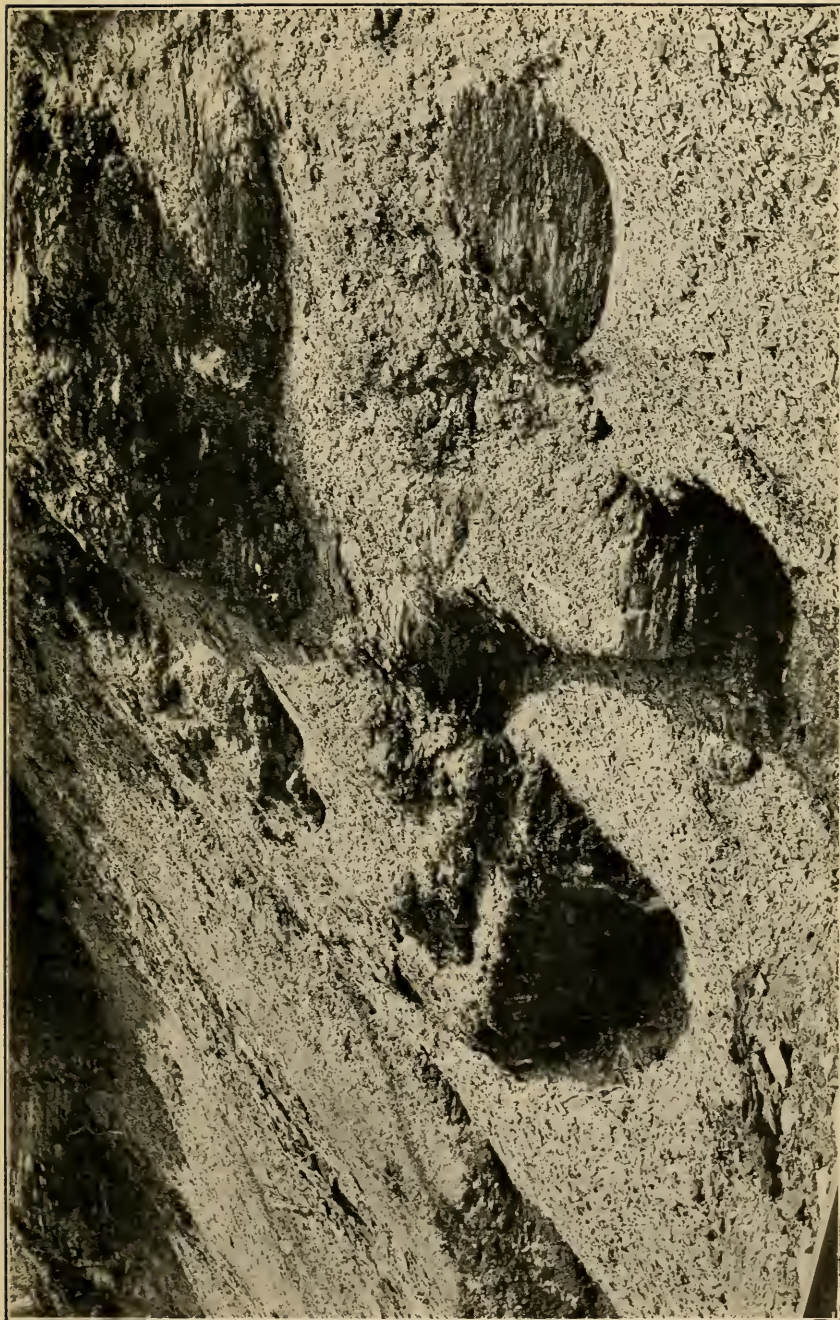


PLATE XXXXI.—Showing the Harlem Coal and the marine fossiliferous Ames Shale and Limestone along M. & K. Ry. grade, 1½ miles northeast of Kingwood Coal is at track level and fossils at horizon of hammer.

Photo by E. E. Knight

One-half mile southwestward, Reger collected a sample of ore in a digging at the same horizon, at an elevation of 1300' A. T., aneroid measurement, the composition of which, as reported by Messrs. Hite and Krak under Laboratory No. 601H, is as follows:

	Per cent.
Silica (SiO_2)	27.97
Metallic Iron	44.58
Lime (CaO)	8.07
Sulphur	0.03
Phosphorus	0.055

In Grant district, the Irondale ore seems fairly persistent, although frequently only a few inches in thickness. Reger reports it in the public road on the east hillside of Hazel run, 2.2 miles northeast of Laurel Church, at an elevation of 1670' A. T., aneroid measurement; and again in the road, 1.4 miles northeast of Brandonville, where it is 2 feet in thickness at an elevation of 1830' A. T., aneroid measurement.

In the western edge of Pleasant district, it is 2 feet thick at its crop in the public road, 1 mile south of Rockville, according to Reger, at an elevation of 1660' A. T., aneroid measurement.

In the southeastern edge of the same district, the Irondale horizon formerly supplied a part of the ore used in the old Josephine furnace. Here at an old ore digging, Reger collected a sample for analysis from No. 8 of the section published on page 157, under the description of the Upper Freeport limestone, the composition of which, as reported by Messrs. Hite and Krak under Laboratory No. 802H, is as follows:

	Per cent.
Silica (SiO_2)	22.22
Metallic Iron	43.62
Lime (CaO)	4.45
Sulphur	0.04
Phosphorus	0.17

The results show the ore having practically the same composition as in the Irondale region of Preston county.

Buhrstone Iron Ore.—The Buhrstone iron ore, belonging between the Lower Kittanning and Clarion coals, and associated with and frequently replacing the Vanport limestone,

was observed at a few localities in Preston county. In the western portion of Grant district, Reger reports an old digging in this ore, 25 feet above the Homewood sandstone and near the old Greenville furnace on Laurel run, 1.5 miles north of Laurel Church. The prospect had fallen shut, but the horizon probably furnished a portion of the ore used in the latter furnace. This was the only prospect noted on this horizon.

The crop of the two foregoing iron ores of the Allegheny series should follow closely the same localities of Preston as outlined on Map II for the Upper Freeport and Lower Kittanning coals, respectively.

Iron Ores of the Pottsville Series.

An examination of the Rowlesburg section, page 97, measured along the Baltimore and Ohio railroad grade between Anderson and Rowlesburg, where the Pottsville strata were completely exposed, shows two shales quite rich in iron ore nuggets; one, belonging just over the Upper Mercer coal; and the other, about 25 feet below the Quakertown coal. These two horizons probably constituted the main source of supply of Pottsville ore that was formerly prospected along the crest of Chestnut Ridge in the western edge of the territory of this report. All the diggings had fallen shut in the latter region, so that it was not possible to ascertain the character of the ore. The detailed crop of the Pottsville series is given on Map II, which should aid quite materially special investigations of the iron resources of these measures.

Iron Ores of the Mauch Chunk Series.

That portion of the Mauch Chunk series for 30 to 50 feet below the base of the Pottsville was once quarried quite extensively for iron ore along the crest of Chestnut Ridge, in the extreme northwestern edge of Grant district. Both hematite and carbonate ores occur, and these shales probably furnished most of the iron obtained from Valley and Greenville furnaces. All the diggings had fallen shut when visited during 1912, so that it was impossible to determine the thickness and charac-

ter of the ore in this wooded region. Their line of crop can be closely determined in Preston, since they should follow closely the division line between the Pottsville and Mauch Chunk as designated on Map II.

Composition of the Old Furnace Ores.

In his report for 1839³, Rogers gave a number of analyses of the iron ores used at the old furnaces of Preston and Monongalia counties, which, as published on pages 121-122 of Volume IV of the State Survey Reports, are as follows:

"The analyses were based on a quantity of 25 grains and are here given on a basis of 100.

"Greenville Furnace Ores (Rogers)

	I.	II.	III.	IV.
Iron carbonate	93.08	64.32	60.60	71.16
Lime carbonate	trace	trace	trace	1.40
Magnesium carbonate	trace	trace	trace	.....
Silica	4.48	27.20	31.20	22.48
Alumina	0.80	4.16	3.76	2.96
Water	1.24	1.20	2.00	1.64
Manganese carbonate.....	trace	trace	trace	trace
Metallic iron	44.95	31.06	29.27	34.37

"I. A compact ore, reddish brown from upper seam at furnace in shales below the conglomerate.

"II. Rock vein, 10 feet below last and 8 to 15 inches thickness.

"III. Another sample from Rock vein, gray color, earthy fracture, vegetable remains and mica scales.

"IV. Lower vein which is 8 to 10 feet below Rock vein and average thickness 4 inches, dull reddish brown color.

"Rogers gives in the 1839 report the following analyses of ore at Henry Clay and Valley furnaces in Monongalia and several ores from Preston country, which are here computed on 100 per cent. basis:

	V.	VI.	VII.	VIII.	IX.	X.
Iron carbonate.....	89.12	76.72	78.20	92.00	82.56	66.68
Lime carbonate .....	.....	3.72	4.40	.....	2.24	0.60
Magnesium carbonate }	0.80	.....	.....	1.20	.....	.....
.....	.....	2.80	3.00	.....	3.76	0.76
Silica	7.48	12.72	11.20	4.08	8.44	24.96
Alumina	1.40	2.04	1.40	1.20	2.12	3.88
Water	0.88	1.76	2.00	1.12	1.04	2.64
Manganese carbonate..	trace	trace	trace	trace	.....	trace
Metallic iron.....	43.04	37.05	37.77	44.43	39.87	46.67

³Geology of the Virginias. pp. 401-404.

"V. Ore from upper vein below conglomerate at Henry Clay furnace, gray ore with reddish brown tint, compact texture, and fine grain.

"VI. Valley furnace ore, reddish brown color, compact texture, contains vegetable impressions.

"VII. Valley furnace, Monongalia county, ore, called by miners, kidney ore, bluish gray color.

"VIII. Iron ore below conglomerate, German settlement, Preston county, bluish gray to brown.

"IX. Hollow run, a branch of Muddy creek, Preston county, dark blue ore, compact texture.

"X. Iron ore from coal measures, M. Hartman's, Crab Orchard, Preston county, color deep red to brown, compact texture and fine grain."

WATER POWER RESOURCES.

Present Development.

Hydro-Electric Company of West Virginia.—As described at length on pages 776-777 of the Monongalia-Marion-Taylor Report, the Hydro-Electric Company of West Virginia, formerly known as the West Virginia Development Company, has already begun the construction of a great dam—80 feet high—on Cheat river in Monongalia county, 500 feet southeast of the Pennsylvania-West Virginia State line, and 8 miles northwest of the same stream's intersection with the Monongalia-Preston county line. The same company has already done considerable core test drilling on Cheat within the territory of this report to determine a suitable foundation for a similar dam one mile above Beaverhole, just below the mouth of Bee run; also on Big Sandy creek, just below the mouth of Laurel run; and another, between Bruceton Mills and Clifton Mills, 0.4 mile north of the mouth of Glade run. The plans, just below the mouth of Laurel, contemplate a dam 200 feet in height, while those at the latter locality were based on a height of only 90 feet. Owing to financial difficulties during 1913, this company was compelled to suspend construction on the dam first mentioned above in Monongalia county, as well as any projected work in Preston.

Available Power.

It is only within recent years that the subject of water power has attracted the attention of the American people to the fact that its development to the economic limit is one of the best means of conserving and prolonging the life of our rapidly depleting supply of mineral fuels. In addition to an immense tonnage of available coal, Preston county is specially favored by nature in the possibilities of developing a large amount of water power. A very interesting comparison of the costs of steam and water power is given in the following statements of A. H. Horton, District Engineer, Water Resources Branch of the U. S. Geological Survey, taken from pages 391 and 392 of the Semi-Centennial History of West Virginia, by J. M. Callahan, published in 1913:

" * * * * * the minimum amount of energy developed by the streams in West Virginia is about 350,000 horsepower, the assumed maximum is 1,163,000 horsepower. It takes from 11 to 15 tons per year of high grade steam coal to produce one continuous horsepower in the most efficient steam engines in ordinary use. The amount of coal, based upon the lower of the above figures, necessary to produce the minimum horsepower developed by West Virginia streams is therefore 3,850,000 tons per year, to produce the maximum, 12,800,000 tons per year.

"The annual cost of producing power by steam plants varies from about \$25.00 to \$150.00 per horsepower, depending upon the type of engine and boiler and the capacity of the plant. These figures include interest at 5 per cent., depreciation, repair, oil, waste, labor and fuel, using coal at \$2.00 per ton.

"Water power must, of course, compete with steam power, derived in general, from coal. It will, therefore, remain undeveloped unless it can be disposed of at less cost, except to certain customers who will pay higher price for the convenience of obtaining electrical power.

"It costs from about \$45.00 to \$200.00 per horsepower measured at the turbine shaft to construct water power plants ready to deliver electrical power. This electrical power can be sold for less in the immediate vicinity of the power plant than anywhere else as the cost of transmission is considerable and varies with the distance, voltage, and amount transmitted.

"To prevent a threatened water power monopoly and reduce rates for electricity, the Province of Ontario, Canada, created a Hydro-Electric Power Commission in 1906 with full power to control plants and to buy and sell power. This Commission is now operating 300 miles of 110,000 volt main transmission lines, and 180 miles of distributing lines, buying current from the Ontario Power Company, a private corporation at Niagara Falls, at \$9.00 per horsepower per annum. The rates charged the municipalities to cover cost, vary from \$18.00 to \$29.50 per horsepower per annum, according to distance. The

Commission is supplying at present 30 municipalities. The City of Toronto, located approximately 90 miles from the source of power, purchases 10,000 horsepower from the Commission at the rate of \$18.50 per horsepower per annum for 24-hour service, which is very much less than it would cost if produced by steam plants.

"What has been done in Ontario, Canada, can be done in West Virginia or any other State. At present there is very little hydro-electric power developed in this State and the passing of laws to regulate the price of electricity for use as power or for illumination ought not to be a difficult matter. The need of legislation or of a Commission to regulate charges for electricity is shown by the fact that at Buffalo electricity costs \$25.00 per year per horsepower, while at Toronto, which is three times as far as Niagara Falls, the common source of power, the price is 26 per cent. less."

The two following tables by Mr. Horton, taken from pages 420 and 421 of the same History of West Virginia, exhibit the indicated horsepower available on Cheat river and Big Sandy creek, respectively:

Table No. 13.—Indicated Horsepower Developed by Cheat River.

Section of River.		Length Miles	Mean Drainage Area, Sq. Mi.	Minimum Discharge Sec. Ft.	Assumed Discharge for Maximum Development. ment. Sec. Ft.	Total Fall. Ft.	Minimum Horsepower	Assumed Maximum Development. Horsepower.	Horsepower available from storage for		
To	From								12 mos	6 mos	3 mos
Source.....	3,000 ft. Contour.....	30	a88	24	59	1,500	826	2,030	.....	.....	.....
	3,000 ft. Contour.....	45	151	41	101	1,370	5,160	12,700	.....	.....	.....
	Above Dry Fork.....	45	865	151	454	b440	6,120	22,100	.....	.....	.....
	Below Dry Fork.....	45	865	151	454	b440	6,120	22,100	.....	.....	.....
	Albright.....	29	1,220	214	770	400	7,880	28,300	.....	.....	.....
	Albright.....	29	1,220	214	770	400	7,880	28,300	.....	.....	.....
	Mouth.....	29	1,220	214	770	400	7,880	28,300	.....	.....	.....
	Totals.....	149				3,710	19,986	65,130	.....	.....	.....
a. Total area. b. Fall reduced to 280 ft. by proposed Cheat River reservoir.						3,710	19,986	65,130	.....	.....	.....

Owing to the importance of this subject to the citizens of Preston and adjoining counties, and in order to show that not all the power exhibited in the above tables is economically available at present, the following statements by Mr. Horton, from pages 394 and 395 of the last mentioned History, are given space in this report:

"The schedule presented in this report gives the amount of available water power according to three classifications—(1) that which may be produced by the minimum flow; (2) the assumed maximum development; and for a few selected streams (3) the power that may be developed from storage capacity in the upland basins and using stored water to compensate the low water periods. The data as a whole have been considered without reference to present practicability of development or present market. For purposes of this report it has been assumed that all the power in West Virginia will some day be required. Such an interpretation is the logical one when natural resources are being considered. In other words, the schedule here presented must be interpreted for the future rather than for the present. The reader should not assume that all the power here shown is economically available today. Much of it, indeed, would be too costly in development to render it of commercial importance under the present conditions of market and the price of fuel power. The schedule shows, therefore, what will be the maximum possibilities in the day when our fuel shall have become so exhausted that the price thereof for production is prohibitive, and the people of the country shall be driven to the use of all the water power that can reasonably be produced by the streams.

"The rivers have been divided into sections of varying length, determined by channel slope, and the fall and flow of each section have been obtained from the best available source of information. In determining the flow for the various sections, the data of flow per square mile, procured from the sources above mentioned have been applied. The drainage areas above the upper and the lower limits of each section have been determined and a mean taken for the whole section. This has been used as a factor along with the flow per square mile in determining the minimum flow for that section. This figure, together with 90 per cent. of the total fall from head to foot, has been used to determine theoretical horsepowers, according to the usual formulas. It is obvious that in practice the entire fall along any stretch of river or at any power privilege cannot be effectively utilized. In few places can even 90 per cent. be utilized at the present time; but, inasmuch as these figures are supposed to cover future as well as present practice, and inasmuch as it may reasonably be assumed that future practice in water power installation will improve, it is believed that 90 per cent. of the fall along any particular section may eventually be realized. Where a stream has been considered from its source to its mouth but 25 per cent. of the power obtained by using the total fall and the flow at the mouth has been used, other factors being the same.

"The results of calculations of theoretical power on 90 per cent. total fall have been reduced 10 per cent. to allow for inefficiency of wheels. It is recognized that 90 per cent. efficiency is too high to be used in calculations of power at the present time, 75 or 80 per cent.

being the usual installation maximum. Here, again, however, we are computing for future conditions, as well as present ones, and it may confidently be expected that, with the improvement of turbines, a greater percentage of the theoretical power will be realized on the shaft and improvement will before long render possible a 90 per cent. efficiency.

"In determining the minimum horsepower, the average of the mean flow of the two lowest seven-day periods in each year was determined and the mean of these values for the period of record was taken as the minimum flow. It is obvious that this is somewhat higher than the absolute minimum, but the latter is usually of so short duration that it does not equal the practicable minimum that may profitably be installed.

"The assumed maximum economical development has been determined on the assumption that it is good commercial practice to develop wheel installation up to that amount the continuance of which can be assured during six months of the year, on the assumption that the deficiency in power during the remainder of the year can be profitably provided by the installation of fuel power plants as auxiliaries. In many parts of the country it has been shown conclusively that it is economical to develop up to that amount which can be had continuously during the highest four months of the year, and, while it is probable that there are parts of the country where the limit should be the highest eight or ten months, it is believed that the period used in these schedules is a very conservative average. The minimum weekly flow for each month of the year has been arranged according to magnitude, and the sixth value has been taken as the basis for estimating the power, the mean of these values for the record period in each case being that used in the computations."

In addition to Cheat river and Big Sandy creek, several other tributaries of the former within the territory of this report possess favorable sites for the development of water power on a much smaller scale; especially is this true of Muddy and Roaring creeks. However, the minimum development on these during portions of the year would be very low as compared to the maximum.

MINERAL WATERS.

There is more or less mineral matter in solution in all spring water, but a greater percentage of certain minerals in some springs often gives them medicinal qualities of great value for many of the diseases that affect mankind. Preston county may possess several such springs, but only one has been commercialized on the basis of curative qualities.

Medicinal Springs.

Irondale Spring.—This spring is located in the western edge of Lyon district at Irondale, having its outlet through alluvial and probably slag debris from the old Irondale furnace, now abandoned for 32 years, which lies in contact with Allegheny rocks, and is owned by the Man-a-cea Water Company, No. 13 Stone St., New York City. According to information given Hennen by a foreman at the spring, the capacity is 1500 cases monthly, each case holding 12 one-half gallon bottles. The output is hauled in wagons to the terminus of the Hardman switch of the Baltimore and Ohio Railroad and the greater portion shipped to the company warehouse in New York City. It is distributed at the rate of \$5.00 a case, f. o. b. New York or Spring. The testimonials of consumers suggest its worth in the treatment of kidney, liver and stomach ailments.

In the circulars advertising this water, the following analysis is given for the same as determined by Prof. A. A. Breneman of New York:

	Grains per Gallon.
Potassium Sulphate.....	1.538
Sodium Sulphate	0.455
Calcium Sulphate	18.161
Magnesium Sulphate	0.966
Aluminum Sulphate	0.671
Ferrie Sulphate	0.003
Manganese Sulphate	0.342
Sodium Chloride.....	0.327
Calcium Carbonate	1.169
Silica	0.998
Organic matter, etc.....	1.371
Saline water, etc.....	0.251

J. B. Krak, Assistant Chemist for the Survey, made a special trip to the Irondale spring to obtain a sample of the water for analysis, but was refused permission to collect the same. However, through the aid of a local druggist, the Survey was able to get two bottles from a drug store handling this water in Pittsburgh, Pa., the composition of which, as reported by Messrs. Hite and Krak, is as follows:

	Parts per Million Reacting Value	
Suspended Matter	0.00	
Colloidal Matter:		
Silica (Si O ₂).....	15.80	
Dissolved Radicles:		
Iron (Fe)	0.04	0.001
Alumina (Al)	0.01	0.001
Manganese (Mn)	0.11	0.004
Calcium (Ca)	94.60	4.72
Magnesium (Mg).....	3.20	0.26
Sodium (Na)	6.90	0.30
Potassium (K)	10.70	0.27
Total Positive Radicles.....		5.556
Carbonate (CO ₃)	0.00	0.00
Bicarbonate (HCO ₃)	48.80	0.80
Sulphate (SO ₄)	230.90	4.80
Chlorine (Cl).....	1.00	0.03
Nitrate (NO ₃)	1.50	0.02
Total Negative Radicles		5.65

Iron Magnesium Spring.—This spring is located on the north side of Snowy creek between the latter stream and the Baltimore and Ohio railroad, $\frac{1}{2}$ mile southeast of the Terra Alta station, having its outlet near the top of the Chemung rocks. A company was recently incorporated to sell this water on a commercial scale. The following account of efforts to commercialize this spring, as also a report on the same by a reputable chemist, is taken from the "Preston Republican" of December 31, 1908, on the authority of Rev. C. H. King, of Terra Alta:

"Residents of and summer visitors to Terra Alta have access to as fine a spring of water as exists in this or any other country to-day. We refer to the 'Eureka Spring' located on the Gillis place, less than half a mile east of the B. & O. station. The water is absolutely pure besides which it contains health giving properties which make it a formidable rival to any spring in the country, once this fact becomes generally known. The water bubbles forth in such generous quantity that the owner is now thinking of putting it on the market.

"The spring is located on the old Nat Ward Fitz Gerald place, but which in 1896, passed into the possession of James A. Gillis. In 1891, Col. Fitz Gerald had the water analyzed, sending samples for that purpose to E. T. Fristoe, an eminent chemist and assayer, of Washington, D. C. We append Mr. Fristoe's report:

"Columbian University,

"Washington, D. C., Feb. 15, '91.

"Col. Ward Fitz Gerald,

"Dear Sir:—The following is our report upon the analysis of the sample of water sent us from your springs on the 12th inst.

"Analysis showed solid matters, (minerals), per gallon of 1.5 grains, consisting of Sulphates of Iron (mostly), Calcium, Sodium Sulphate, Sodium Chlorides, Magnesium Sulphate, Aluminum Sulphate, Silica and Free Sulphuric Acid.

"Remarks.—This is certainly one of the most remarkable waters in the world. It is absolutely pure; containing no organic matter—a result rarely, if ever, met with.

"It is like the celebrated Poland water of Maine. The great curative effects of the water from your springs are due to sulphate of iron, and free sulphuric acid, and to its wonderful purity. Curative effects are not always due to large quantities of minerals, but to their happy combination in small quantities, as I find them in this water, as far as the salts in solution are concerned; and the small quantities of other minerals besides iron are all of a medicinal character.

"Very respectfully,

(Signed)

"E. T. FRISTOE,

"Chemist and Assayer.

"Col. Fitz Gerald at one time attempted to market water from this spring, but met with reverses through the burning of his fine large summer hotel before its completion and abandoned the project."

Mr. Krak collected a sample of the water from this spring for analysis, the composition of which as determined by himself is as follows:

	Parts per Million Reacting Value	
Suspended Matter.....	0.00	
Colloidal Matter:		
Silica (Si O ₂).....	9.50	
Dissolved Radicles:		
Iron (Fe).....	0.04	0.001
Aluminum (Al).....	0.03	0.003
Calcium (Ca).....	6.00	0.29
Magnesium (Mg).....	2.00	0.16
Sodium (Na).....	4.90	0.21
Potassium (K).....	2.20	0.05
Total Positive Radicles.....		0.714
Carbonate (CO ₃).....	0.00	0.00
Bicarbonate (HCO ₃).....	33.20	0.54
Sulphate (SO ₄).....	8.40	0.17
Chlorine (Cl).....	1.90	0.05
Nitrate (NO ₃).....	0.54	0.009
Total Negative Radicles.....		0.769

The results of the above test for the Survey show this to be a very pure good water for drinking purposes, possessing only very small quantities of mineral matter in solution and

its character harmonizing with the statements in the latter part of the last paragraph in the above by Fristoe.

According to Mr. Krak this spring should furnish a large amount of water, since he reports it flowing with a stream 2 to 3 inches in diameter on the date of his visit in February, 1914.

FORESTS.

A very complete description of the forests of the State by counties is given in Volume V, Chapter VI, of the State Geological Survey, by A. B. Brooks, State Forester. The following, taken from pages 250-253 of the latter volume, gives interesting data on the timber resources of Preston county:

"Original Timber Conditions.

"Preston was once an immense forest containing practically all the common hardwoods on its lower lands, and areas of spruce, white pine and hemlock along its cold mountain streams and uplands. The spruce grew principally on Snowy creek, the head of Saltlick creek, and in the vicinity of Cranesville. White pine was found in limited quantities near Cranesville and on Threefork creek. Pitch pine was once common on Snaggy mountain east of Terra Alta. Chestnut, poplar, white oak, red oak, chestnut oak, ash and hickory may be mentioned as the principal hardwoods.

"When the first settlers came into Preston country area there were open glades scattered here and there in the wilderness that attracted their attention. There were the glades at Cranesville, at Reedsville and in the vicinity of Terra Alta, as well as those on Sandy creek and in several other places. Washington speaks of the Sandy creek glades as having a 'pretty appearance, resembling cultivated fields and improved meadows at a distance.' 'Here fire, storm, heat or cold had brushed away the forests and laurel thickets, and in their place waved long grasses and wild flowers on the highland mountain summits. For scores of miles not a tree was to be seen save where little rivulets traced a course toward the Ohio or the Potomac. These smiling meadows on the roof of the Alleghanies are not more popular with summer tourists to-day than with the large game-animals, the deer, elk and buffalo of a century ago. When the pioneers came the glades were the great pasture grounds for all who could reach them.'*

"The above description was written of the glades in Allegany and Garrett counties, Maryland, and Preston county, West Virginia, but this 'scores of miles' must refer to conditions outside the state as the open, grass-covered glades were comparatively small on the West Virginia side. Most of the glade land, in fact, was overgrown with shrubs and some of it with dense stands of trees. An example of this was the Pine Swamp located on the Maryland line near the town of Cranesville, which had a forest of spruce, white pine, hemlock, wild cherry and tamarack.

*"Washington and the West," p. 120.

"The Lumber Industry.

"Although settlements were made at Bruceton, Reedsville, Kingwood and Aurora before the beginning of the 19th century, 'the whole country,' says Major Orr, 'was covered with timber in 1840 except the small farm openings of the scattered settlements.'

"Here, as in other counties, the pioneers made use of the excellent water-power of the mountain streams for the manufacture of lumber on primitive saw mills, used almost exclusively for the first 50 or 75 years. The names and locations of a few of the old saw mills are given below:

"Joseph Ringer's mill, on tributary of Muddy creek of Cheat.

"Zeller's mill, near the mouth of Roaring creek.

"Friend's mill, on Daugherty creek.

"Gandy's mill, on Maple run.

"Thos. Waters' mill, on Raccoon creek.

"David Fortney's mill, on Threefork creek.

"Henry Albright's mill, on Muddy creek of Youghiogheny.

"Browning's mill, on Muddy creek of Youghiogheny.

"Wakefield's mill, on Muddy creek of Youghiogheny.

"The first circular steam saw mill was brought to the county by James Cain, who began to operate it about two miles south of Tunnelton in 1854; the second was put in operation in 1865 by Maj. U. N. Orr about two miles east of Newburg; and two years later the third was brought in and stationed near Austen by Martin L. Shaffer. Soon after this—beginning about 1870—portable steam mills began to scatter into all parts of the county.

"A. A. Perry and Company operated a gang saw mill and stave factory at Rowlesburg from about 1870 to 1879. This mill was largely supplied with logs that were floated down the Cheat.

"Hinkle and Company did an extensive business with a circular mill at Rowlesburg from 1885 to 1895.

"The stave industry was begun at Independence in 1853, the next year after the Baltimore and Ohio railroad was completed to that station. A company of Philadelphia lumbermen bought a large number of excellent white oak trees in that section and used and wasted them in this industry. Nearly all the portable saw mills used their slabs and small timber in the manufacture of staves, in this way showing themselves less wasteful than many of the present operators.

"The tan-bark industry has been carried on from 1876 to the present. Chestnut oaks have been peeled in almost every section and the bark hauled in wagons to the Baltimore and Ohio railroad.

"There have been no operations larger than the gang saw operation at Rowlesburg; and practically all the timber cut in the county has been sawed on small portable mills, of which there are about 100 still in operation.

"Present Forest Conditions

"There are scattered tracts of virgin timber in the county which aggregate about 30,000 acres. These lie almost entirely along the Cheat river and on Roaring creek, Big Sandy and Laurel run. The narrow belt of virgin timber lying along the steep bluffs of the Cheat and lower course of Big Sandy creek is not good in quality nor easily accessible. The tracts lying on land which is not so steep, however, contain excellent stands of timber. The cut-over forest lands, aggregating about 58,000 acres, are found in several widely scattered areas, some lying on the Cheat river near the Tucker line, some on Brushy

and Briery mountains, and others on the heads of Muddy run and on Cheat near to the Monongalia line.

"Grain, vegetables and fruits are successfully grown in nearly all parts of the county and much of the remaining woodland will probably be cleared for agricultural purposes."

Areas Suitable for Reforestation

There is a large area in Preston county that is unfitted for agriculture, owing to the rough and stony character of the surface, that could be reforested at great profit to the citizens of the county, if the matter were taken up in a systematic manner under proper forestry laws to minimize fire and encourage tree planting. This area lies mostly in the regions where the surface topography is affected by the crop of the Pottsville series (See Map II), but it is shown much more completely on Map III (Showing Soils) by the symbol designating "Rough and Stony Land." An accurate planimetric determination of the latter area by Gawthrop from Map III by districts, gives the following results:

Table Showing Acreage Adapted to Reforestation by
Districts.

Districts.	Square Miles	Acres.
Grant	25.4	16,256
Pleasant	27.7	17,728
Valley	17.2	11,008
Lyon	5.2	3,328
Kingwood	8.4	5,376
Portland	41.2	26,368
Reno	31.5	20,160
Union	27.5	17,600
Total for County.....	184.1	117,824

The utility of forests and the great benefits that would be derived in applying a systematic plan of reforestation to the above areas are well brought out by A. B. Brooks in Volume V, pages 17 to 47, inclusive, of the State Geological Survey Reports.

CHAPTER XV.

SOIL SURVEY OF PRESTON COUNTY, WEST VIRGINIA.

By W. J. Latimer.

The three following tables, giving climatological data for Preston county, were secured through the courtesy of Mr. H. C. Howe, Section Director, United States Weather Bureau. Parkersburg, West Virginia, in addition to the three tables secured by Mr. Latimer and published on pages 10 and 11 of his original report on the Preston county area to the U. S. Dept. of Agriculture, which is herein given in full, omitting the first 9½ pages:

U. S. Department of Agriculture, Weather Bureau.

Station, Terra Alta; County, Preston; State, West Virginia. Data, Monthly Mean Temperatures, with Averages.

Year.	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Annual.
1893.....	19.1	32.4	38.0	50.8	57.6	67.9	71.2	68.0	62.4	52.8	39.3	35.2	49.6
1894.....	35.9	31.4	46.5	50.3	61.7	71.5	73.3	70.8	67.3	54.3	39.2	27.4	52.6
1895.....	26.6	19.2	37.4	51.4	62.8	75.1	70.7	73.9	70.5	48.1	45.3	37.1	51.5
1896.....	29.9	30.7	32.1	....	63.1	63.4	67.5	66.8	60.0	45.9	45.8	33.2	....
1897.....	26.0	34.7	45.4	49.7	55.7	65.3	70.9	65.4	60.1	55.4	44.2	32.8	50.5
1898.....	34.0	29.8	46.7	44.7	60.4	67.8	72.4	71.2	65.2	53.9	39.8	30.4	....
1899.....	....	....	....	....	....	67.1	63.7	65.8	54.6	48.0	....	....	....
1900.....	30.0	26.2	32.8	49.8	63.8	68.6	73.3	74.0	71.0	57.4	42.6	31.4	51.7
1901.....	25.2	19.1	38.0	....	....	....	....	....	....	....	36.6	29.1	....
1902.....	24.6	20.6	39.0	44.2	59.8	62.0	68.4	64.3	60.3	52.8	46.5	28.6	47.6
1903.....	25.8	29.4	45.8	46.8	60.0	59.7	66.5	65.6	61.2	50.6	34.2	22.5	47.3
1904.....	24.0	26.2	42.6	44.2	59.6	65.2	68.2	67.4	64.2	....	....	....	....
1905.....	24.4	21.0	41.3	47.1	59.6	67.0	71.1	66.8	63.0	55.1	41.8	33.0	49.3
1906.....	31.6	29.4	29.0	48.8	59.7	66.2	68.4	71.0	68.2	52.9	44.7	31.0	50.1
1907.....	33.5	24.6	44.2	39.8	53.8	61.8	68.8	65.7	61.6	47.1	39.2	31.6	47.6
1908.....	28.8	23.0	42.7	50.6	58.0	68.4	72.0	68.4	63.8	52.6	45.9	....	....
1909.....	32.6	35.5	35.2	50.2	55.1	69.1	66.2	67.4	58.4	49.2	47.1	28.0	49.5
1910.....	27.2	25.6	50.2	52.8	56.2	64.8	72.8	69.8	....	....	....	....	....
1911.....	35.5	32.5	32.5	42.8	63.9	69.9	69.2	66.6	59.6	....	....	....	....
1912.....	23.4	....	....	....	61.0	61.8	66.6	62.5	63.0	51.2	....	....	....
Means.....	28.3	27.3	40.0	47.8	59.5	66.5	69.5	68.0	63.0	51.7	42.1	30.8	49.5

Remarks.—The record for 1893, 1897, and 1898 was made at Kingwood. For 1894, 1895, and 1896 at Tannery.

U. S. Department of Agriculture, Weather Bureau.

Station, Rowlesburg, W. Va. Data, Monthly Precipitation, Rain and Melted Snow (in Inches and Hundredths).
(Figures in bold-face type estimated from surrounding stations.) Elevation, 1375 feet.

Year.	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Annual.
1884.....	...	...	...	...	...	...	...	...	...	...	...	3.57	...
1885.....	4.89	2.98	2.37	3.15	1.90	1.35	2.56	3.87	0.75	6.07	2.79	0.37	33.05
1886.....	0.94	0.52	2.72	1.99	4.58	3.61	0.47	2.38	1.23	0.10	0.47	0.13	19.14
1887.....	3.35	2.23	2.30	4.80	3.80	5.15	2.34	3.39	4.10	1.57	2.37	1.88	37.28
1888.....	6.15	2.50	4.74	2.65	4.32	1.72	5.50	5.60	5.00	1.39	1.65	1.10	42.32
1889.....	2.71	1.56	0.95	3.23	2.05	5.30	5.17	1.67	2.86	2.36	4.83	3.05	35.74
1890.....	4.69	5.54	4.46	6.14	8.09	4.67	2.92	5.44	4.39	4.62	2.22	3.28	56.46
1891.....	2.52	5.62	4.08	4.20	4.25	3.79	4.70	5.49	1.62	2.69	4.16	5.93	49.05
1892.....	2.92	2.08	3.45	4.84	5.87	3.42	3.56	2.38	2.13	1.55	4.94	2.77	39.91
1893.....	2.14	3.84	1.06	5.70	4.48	3.87	3.82	2.00	1.78	3.41	1.96	2.20	36.26
1894.....	2.63	3.98	2.71	4.81	7.40	2.80	3.99	2.29	2.84	2.27	3.44	6.18	45.34
1895.....	2.98	0.99	4.26	4.78	2.98	3.40	4.34	1.89	0.42	1.15	2.75	2.75	31.79
1896.....	1.65	3.11	1.76	1.00	3.21	6.61	12.14	1.18	3.49	2.93	2.20	1.81	41.09
1897.....	2.20	5.08	4.29	4.07	3.60	4.57	4.47	4.52	1.95	0.65	6.70	7.24	49.34
1898.....	6.62	2.12	6.72	4.77	4.73	2.57	1.53	5.70	1.59	2.48	2.52	2.98	44.33
1899.....	3.94	3.30	6.78	2.31	5.72	7.69	4.70	2.96	2.85	0.80	3.49	3.10	47.64
1900.....	2.80	3.92	4.57	1.05	1.36	6.96	2.70	4.88	1.26	2.01	3.77	1.32	36.60
1901.....	3.05	1.54	4.01	5.02	2.71	4.20	3.13	4.31	2.68	0.53	3.60	7.10	41.88
1902.....	4.97	2.69	4.42	4.08	3.26	5.27	5.74	2.53	3.01	4.52	3.29	7.91	51.69
1903.....	4.34	6.55	5.06	4.24	3.48	7.63	4.10	3.65	1.54	3.33	2.83	3.09	49.84
1904.....	3.61	3.16	5.16	3.58	2.87	4.00	4.60	2.37	4.87	2.25	0.76	4.26	41.49
1905.....	3.98	2.99	6.14	3.63	4.67	6.32	7.68	5.76	2.53	5.35	3.49	3.14	55.68
1906.....	4.64	1.38	5.50	6.40	2.86	5.83	5.65	5.00	4.91	3.20	2.53	7.63	55.53
1907.....	10.67	7.17	7.17	3.86	5.54	5.76	12.84	5.69	3.65	4.30	5.10	4.28	72.13
1908.....	3.70	5.21	8.60	5.20	10.10	3.91	5.00	3.02	0.85	0.33	0.82	4.29	51.03
1909.....	4.30	5.00	4.37	5.82	3.28	8.94	4.52	5.04	3.18	4.86	1.83	3.89	55.03
1910.....	8.33	3.10	0.78	2.82	3.92	8.18	3.26	1.72	4.52	2.12	3.02	3.25	45.02
1911.....	8.63	2.44	4.15	5.31	2.08	7.28	5.63	8.74	5.13	5.88	3.43	4.92	63.62
1912.....	3.23	3.22	7.91	4.23	3.74	4.45	10.42	3.78	5.16	1.73	2.24	3.68	52.79
1913.....	8.68	3.17	4.38	2.50	8.28	4.63	7.02	2.22	2.84	6.20	6.18	3.10	59.20
Means.....	4.30	3.23	4.31	4.01	4.28	4.96	4.98	3.77	2.87	2.78	3.08	3.67	....

U. S. Department of Agriculture, Weather Bureau.

Station, Rowlesburg; County, Preston; State, West Virginia. Elevation 1375.3 feet.
Data, Snowfall in inches and tenths.

Year.	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Annual.
1893.....	15.5	17.0	6.5	1.0	....	....	....	....	....	....	1.0	2.8	43.8
1894.....	14.2	26.0	3.5	5.2	....	....	....	....	....	....	2.8	15.5	67.2
1895.....	13.8	8.0	20.0	1.5	T	....	....	....	....	....	1.0	3.8	48.1
1896.....	5.0	11.0	7.5	1.0	....	....	....	....	....	....	0.2	8.0	32.7
1897.....	14.5	2.0	4.0	.0	....	....	....	....	....	....	1.0	4.0	25.5
1898.....	7.6	10.4	5.0	4.0	....	....	....	....	....	....	11.0	29.8	67.8
1899.....	19.0	23.0	12.0	.0	....	....	....	....	....	....	.0	5.0	60.0
1900.....	8.0	10.0	20.0	2.0	....	....	....	....	....	....	5.0	T	45.0
1901.....	20.0	11.0	4.0	.0	....	....	....	....	....	....	10.7	16.0	61.7
1902.....	18.6	17.0	6.0	25.0	....	....	....	....	....	....	T	16.5	83.1
1903.....	16.0	13.5	.0	.0	....	....	....	....	....	....	6.0	14.2	49.7
1904.....	16.6	10.2	3.0	2.0	....	....	....	....	....	.0	3.3	12.4	47.5
1905.....	32.2	9.5	2.5	.0	T	....	....	....	....	.0	.06	3.1	47.9
1906.....	7.2	7.6	17.5	.0	T	....	....	....	....	3.0	5.8	10.2	51.3
1907.....	10.0	12.5	8.0	9.6	....	....	....	....	....	.0	9.0	8.9	58.0
1908.....	24.4	22.3	T	0.8	....	....	....	....	....	.0	5.7	3.4	56.6
1909.....	10.6	12.1	19.7	13.4	T	....	....	....	....	T	1.8	33.5	91.1
1910.....	19.0	17.4	0.6	T	....	....	....	....	....	T	6.5	19.9	63.4
1911.....	4.7	6.2	13.6	8.0	....	....	....	....	....	.0	2.6	2.0	37.1
1912.....	13.7	6.3	1.7	T	....	....	....	....	....	.0	1.1	11.1	33.9
1913.....	9.0	6.0	2.0	.0	....	....	....	....	....	.0	14.4	5.0	36.4
Means.....	14.3	12.3	7.5	3.5	T	....	....	....	....	0.1	4.3	10.8	52.8

Remarks.—Record for 1893, 1894, and 1895 was made at Tannery. For 1909, at Terra Alta.

CLIMATE.

In general the climate of the county is genial and healthful. The summers are comparatively short, the nights cool, and periods of hot weather are rare and of short duration. The winters are not rigorous, and the periods of extreme cold are not extended. There is ample precipitation for the growing of crops, and it is generally well distributed over the growing season. The prevailing winds are from the west and southwest.

Owing to the physiographic differences in the Ligonier Valley and the country southeast of the Briery Mountains, particularly in elevation, the climatic conditions of the county vary considerably.

One of the most noticeable variations between these sections is in the rainfall. The mean annual precipitation over the Ligonier Valley is about 44 inches, while over the more elevated section it is about 56.12 inches, or more than 12 inches heavier in the higher country.

The rainfall over the western part of the county is relatively light during September, October, and November, and pastures sometimes suffer for want of moisture during these months. In the section southeast of the Briery Mountains the rainfall is more evenly distributed throughout the year, and there is a fair amount of rain during the fall months.

The table below shows the mean monthly and annual precipitation at Terra Alta and Rowlesburg and the average for Grafton, Parsons, and Morgantown. The Terra Alta station is located near the center of the more elevated southeast section of Preston county, and is 2,549 feet above sea level. The Rowlesburg station is in the Cheat River gorge in the Ligonier section of the county, and is 1,402 feet above sea level. In the third column are given the mean rainfall for three stations: Grafton, with an elevation of 985 feet, Parsons, 1,662 feet, and Morgantown, 1,250 feet. While these stations are located in adjoining counties to the west, their records represent fairly well the conditions over the Ligonier Valley section of Preston county. This table also gives the mean monthly and annual snowfall as recorded at Terra Alta, Grafton, Parsons, and Morgantown. No snowfall data for the Rowlesburg station

are available. It will be seen that the snowfall of the mountain section is very much heavier than over the remainder of the county.

**Mean Monthly and Annual Precipitation at Terra Alta,
Rowlesburg, Grafton, Parsons and
Morgantown.**

Month	Rainfall.			Snowfall.			
	Terra Alta	Rowles- burg	Grafton Parsons and Mor- gantown	Terra Alta	Grafton	Parsons	Morgan- town
	<i>Inches</i>	<i>Inches</i>	<i>Inches</i>	<i>Inches</i>	<i>Inches</i>	<i>Inches</i>	<i>Inches</i>
January	4.81	3.81	3.77	26.3	11.1	11.6	8.8
February	3.33	3.20	3.33	12.6	9.0	14.2	5.6
March	5.67	4.30	4.60	14.9	8.5	6.6	6.1
April	3.53	3.98	3.62	12.4	3.3	3.4	2.4
May	5.32	4.29	4.09	Tr.	0.2	0	Tr.
June	6.90	4.60	4.75	0	0	0	0
July	6.79	4.74	4.87	0	0	0	0
August	4.63	3.67	3.65	0	0	0	0
September	3.27	2.60	2.75	0	0	0	0
October	3.45	2.49	2.63	0.7	0.4	0.5	Tr.
November	3.33	3.03	2.85	5.9	2.8	2.8	0.8
December	5.57	3.65	3.51	13.2	7.0	6.9	6.9
Annual	56.60	44.36	44.25	86.0	42.3	46.0	30.6

The table below gives the normal monthly, seasonal, and annual temperature recorded at Terra Alta and for Parsons, Grafton, and Morgantown combined. These figures show a difference in temperature between the different sections of Preston county. The mean annual temperature is lower in the elevated southeastern section than in other parts of the county, while the absolute lowest temperature recorded in the winter and the highest in the summer are shown in the Ligonier Valley, which section is represented by the combined records of Parsons, Grafton, and Morgantown.

Monthly Mean and Absolute Temperatures at Terra Alta, Grafton, Parsons, and Morgantown.

Month.	Terra Alta			Grafton, Parsons and Morgantown		
	Mean.	Absolute minimum	Absolute maximum	Mean.	Absolute minimum	Absolute maximum
	°F	°F	°F	°F	°F	°F
January	27.5	— 7	72	3.5	—16	76
February	24.4	—24	75	28.9	—27	80
March	39.5	—11	81	42.3	— 4	90
April	46.5	12	85	49.8	8	93
May	59.3	25	86	61.4	21	94
June	65.1	33	92	68.0	34	99
July	68.9	33	90	72.4	43	101
August	67.7	34	94	71.0	40	105
September	63.1	29	90	66.1	30	102
October	52.1	19	86	54.1	15	94
November	41.4	5	76	42.6	2	80
December	29.6	—11	62	33.4	—16	80
Annual	48.8	—24	94	51.8	—27	105

It is generally recognized that the growing season is about two weeks later in the spring in the region southeast of the Briery Mountains than in other parts of the county, and that killing frosts occur earlier in the fall in the former section than in the Ligonier Valley. Frosts of enough severity to kill the wheat have occurred in the former section in June. The mountain section has a very short growing season and here early crops and crops which mature quickly should be planted.

The following table gives the dates of the last killing frost in the spring and earliest in the fall, and average dates of the last in the spring and first in the fall at Terra Alta, Grafton, Parsons, and Morgantown:

Dates of Killing Frosts at Terra Alta, Grafton, Parsons, and Morgantown.

Station.	Record, in years	Average date first killing frost in fall	Average date first killing frost in spring	Earliest killing frost in fall	Latest killing frost in spring
Terra Alta.....	10	Oct. 1	May 11	Sept. 15	May 23
Grafton	16	Oct. 7	Apr. 30	Sept. 21	May 22
Parsons	10	Oct. 7	May 10	Sept. 22	May 29
Morgantown	16	Oct. 13	May 1	Oct. 2	May 22

AGRICULTURE.

Up to the time of the Revolutionary War Preston county was covered with hardwood and pine forests, but soon thereafter settlers began to make clearings in this section and to build permanent homes. At first they grew some corn, but depended largely upon hunting for a livelihood. About 1785 wheat growing began in the county, and by 1800 the clearing had covered considerable areas, roads were being built, and agriculture began to take the place of hunting and trapping. Tobacco was also grown by the early settlers for home use, but it is not grown now.

Between 1820 and 1830 the raising of cattle became quite an important industry, and it has been more or less important since that time. Some improvement of breeds has taken place. About 30 years ago some Shorthorns were introduced, and about 20 years ago the Herefords were brought in. These breeds have given general satisfaction. The Polled Angus were introduced about five years ago, and have hardly been in the county long enough to become popular. They seem well suited to local conditions. At present nearly all of the cattle are sold at the age of 2 years. They are driven either to Harrison county, W. Va., or to adjoining counties in Pennsylvania or Maryland, where they are fattened for market. Owing to the relatively severe climate of the county very few cattle are "wintered."

No special attention has ever been paid to dairying, owing, probably, to the distance from large cities. The native dairy stock is composed largely of grade Jerseys. There are several large herds of both Jerseys and Holsteins in the county.

Sheep have been raised in considerable numbers since the early settlement of the county. Until the introduction of the Southdowns in the early eighties the breeds were selected primarily for the production of wool. This industry at one time was one of the most important in the area, and in 1850 several woolen mills were in operation in the county. The Merinos were the most satisfactory and were raised in large numbers. Since the introduction of the Shropshires and Dorsets about 20 years ago for wool and mutton the Merinos have disappeared. The Shropshire and Dorset breeds now constitute

about 80 per cent of the sheep in the county. Although very little wool is produced at present the number of sheep is about the same as in 1870, when the wool industry was at its height. This is due to the increase in mutton breeds. According to the census there were 22,336 sheep in Preston county in 1869 and 23,078 in 1909.

Hogs are kept on nearly every farm. The Chester White breed was introduced about 1875, and the Poland-China about 25 years ago. Other breeds in the county are the Berkshire and Jersey Red. A large number of Poland-China and Chester White crosses are found, and these hogs seem well suited to the conditions and needs of the county. Very few of the strains introduced have been kept pure. The number of hogs has not varied materially in the last 50 years.

Nearly every farmer raises a few horses. Percherons were introduced about 1880, and Belgians since that time. The general stock has been materially improved during the last few years. Draft horses are raised in greater numbers than other kinds, and the local market is largely supplied by home-raised horses.

The crops and the agricultural practices are well suited to the soil and climatic conditions. Corn, oats, wheat, buckwheat, potatoes, timothy, and clover are the principal crops grown.

In the southeastern part of the county, where the altitude is high, the rainfall heavy, and the growing season short, the crop practice differs slightly from that of other parts of the county. Oats, wheat, buckwheat, and potatoes are grown more extensively. Potatoes grown at this elevation are excellent for seed, and are sold to a small extent for that purpose. The growing of seed potatoes should be given more attention.

The soils of the county are best adapted to the production of oats, buckwheat, and potatoes. These crops are profitable and should be more extensively planted, especially potatoes. The relative importance of the latter crop has steadily increased. In 1850 the production was 12,635 bushels, and the census of 1910 shows an output of 124,533 bushels from 1,193 acres.

A relatively large acreage is devoted to oats and buckwheat. As early as 1850 the annual production of oats was 153,496 bushels, of buckwheat 28,283 bushels. Silver Hull

seems to be the most common variety of buckwheat. The Japanese variety, however, gave excellent results in tests made in this county by the experiment station.¹ Wheat had become a crop of some importance by 1849, a production of 36,769 bushels being reported for that year by the census. The acreage now devoted to this crop is probably about the same as for the earlier year stated, as in 1909 the production was 41,860 bushels.

Corn is not grown as extensively as in most other areas so far surveyed in West Virginia, owing to the smaller extent of bottom land in Preston county. In 1849, 144,276 bushels were produced in the county. The production increased considerably between 1880 and 1910. There is a wide difference in the varieties grown in different sections of the county. In general, flint varieties are grown in the southeastern part of the county and dent varieties in the Ligonier Valley section. Rye was formerly a more important crop than at present.

All the vegetables common to this section of the country are grown in gardens with more or less success. Little or no attempt has been made to grow vegetables on a commercial scale. Cabbage, onions, celery, squashes, and tomatoes of excellent quality can be grown on the glade land, and the production of cabbage, onions, and celery, especially, could be extended upon these lands.² Cranberries can be successfully grown on the glade land.³

Orcharding has never been practiced in the county on a commercial scale, although many of the soil types are well adapted to the production of fruit, and some effort has been made around Terra Alta to establish commercial orchards. The soil and climatic conditions are well suited to the apple. Very little of this fruit is shipped from the area, most of the crop being disposed of at local markets, made into cider, or fed to hogs. The trees are generally healthy and long-lived, and the fruit is of good quality and color. Blight, apple scab, and brown spot are the diseases most common in the apple orchards. York Imperial, Rome Beauty, and Grimes Golden are

¹See Bulletin 84, W. Va. Expt. Sta.

²See Bulletin 81 W. Va. Expt. Sta.; Vegetable Gardening in the Mountain Glades.

³Bulletin No. 86 W. Va. Expt. Sta.; Cranberries in West Virginia.

the varieties best suited to the Ligonier Valley, and these are the leading varieties in the younger orchards. Maiden Blush, Smokehouse, and Stayman Winesap are also good varieties for this section. The Baldwin and Tompkins King varieties are grown extensively in the region southeast of the Briery Mountains. The best varieties for commercial orchards here are probably the Oldenburg, Northern Spy, and Baldwin. Orchards, especially commercial orchards, should not be started too close to coke ovens, as the smoke and gases from the ovens are injurious to vegetation and affect apple trees for considerable distances.

Cherries also do well in the county. While these trees are found in large numbers, usually along roads, the fruit is used only for home consumption. The surplus fruit might well be canned for market, so that some revenue would be derived from the trees. The best varieties of cherries are the Morello and Early Richmond of the sour varieties and Black Heart of the sweet. Most of the cherries are sweet, though sour cherries are most in demand. The Ligonier Valley is better adapted to cherries and apples than other parts of the county. This section of the county presents many ideal locations for commercial orchards.

Peaches and plums do well, but are found only in mixed orchards. Strawberries, blackberries, and raspberries thrive, but are grown to only a very small extent.

The production of grapes has never been given much attention. They suffer from fungous diseases and erratic frosts. Concord and Niagara are the varieties that have been found to do best.

Both soil and climate are favorable to the production of hay and forage crops. Timothy yields well. Redtop is sometimes used instead of timothy in the seeding and is often mixed with timothy. Bluegrass does not thrive on many of the soils with the result that permanent pastures are not as common as in most other areas surveyed in this State.

Of the leguminous crops clovers are the most important locally. Clover, particularly crimson clover, is grown to a small extent separately, but red clover is commonly sowed with timothy. A small quantity of alsike clover hay is pro-

duced on low, poorly drained land or it may be sowed with crimson clover. A small acreage of cowpeas is grown. Millet is used as a catch crop when a failure of the other hay crops is threatened.

Maple sugar and maple sirup are produced to some extent and some sorghum is grown for sirup. Bees are kept in a few places.

The following table, compiled from the census reports, gives the acreage and yields of the principal crops grown in the county from 1880 to 1910:

Acreage and Yields of the Principal Crops Grown in Preston County from 1880 to 1910.

Crop.	1910		1900		1890		1880	
	Acres	Yield	Acres	Yield	Acres	Yield	Acres	Yield
		<i>Bushels</i>		<i>Bushels</i>		<i>Bushels</i>		<i>Bushels</i>
Corn	12,438	382,923	12,394	315,460	8,654	200,549	10,823	245,266
Oats	9,461	198,201	10,075	259,890	11,393	212,479	9,988	197,395
Wheat ..	2,822	41,860	5,696	73,490	4,691	42,673	7,102	65,913
Buckwheat	9,389	199,987	7,066	120,990	4,530	51,178	6,423	73,974
Rye	63	859	210	2,460	244	1,858	1,151	8,690
Irish potatoes.....	1,193	124,533	880	92,554	634	45,141	.....	54,372
Sweet potatoes.....	3	345	13	1,449	7	589	22	495
		<i>Pounds</i>		<i>Pounds</i>		<i>Pounds</i>		<i>Pounds</i>
Tobacco	2	745	1	630	3	1,290	10	5,255
		<i>Tons</i>		<i>Tons</i>		<i>Tons</i>		<i>Tons</i>
Total hay.....	26,980	21,947	26,108	25,905	29,800	23,609	18,475	9,338
Timothy	4,494	3,720	.....	.....	.....	.....	.....	.....
Timothy and clover.	18,977	15,478	25,271	25,018	.....	.....	.....	.....
Clover	166	206	344	365	.....	132	.....	129
Millet	70	82	70	94	.....	.....	.....	.....
Other grasses.....	3,273	2,467	423	428	.....	.....	.....	.....

Liming has been practiced for about 15 years. From 25 to 50 bushels per acre are applied at intervals of 4 to 5 years on poor land and 40 to 60 bushels at intervals of 5 or 6 years upon average land. Upon land in a high state of cultivation as high as 100 bushels is used at somewhat longer intervals. Lime is generally applied just after the sod is turned, before the land is harrowed. Under the conditions of supply it is not advisable to use crushed limestone. The present method of burning it in the field is best. Liming is very beneficial to

most of the soil types in the area, but heavy applications should not be made unless the organic supply is maintained.

Commercial fertilizers have been used about as long as liming has been practiced. Their use for many of the crops and practically all of the soils of the county is to be recommended. Acid phosphate, bone meal, nitrate of soda, and "complete" mixtures are most commonly used. The applications are comparatively light. Stable manure is generally applied on land intended for corn and vegetables. Acid phosphate and various fertilizer mixtures also are sometimes applied for corn, and high-grade brands for potatoes and vegetables. For wheat, oats, and buckwheat acid phosphate and bone meal at the rate of 200 to 400 pounds per acre are used. About 150 to 200 pounds per acre of nitrate of soda is sometimes applied as a top dressing for oats and corn. "Complete" fertilizer mixtures are rarely used at the rate of more than 600 pounds to the acre. Many farmers do not use commercial fertilizers, but apply lime and depend upon stable manure and the occasional turning under of a sod to enrich the soil.

A marked increase in the use of fertilizers took place between 1890 and 1910. According to the 1910 census, 1,081 farmers out of a total of 2,824 reported the use of fertilizers. The 1880 census reported an expenditure of \$5,511 and the 1910 an expenditure of \$36,694 for fertilizers.

A rotation system admirably adapted to the county is: (1) Corn; (2) spring oats; (3) wheat (winter), with clover and timothy; (4) grass; (5) buckwheat (after turning sod); (6) grass; (7) grass. This gives a seven-year rotation. It should be varied, however, according to the particular soil type, giving more corn to the bottom-land soils, more wheat to the limestone soils, more oats to the Upshur silt loam, and more buckwheat, timothy, and clover to the Dekalb soils. A part of the land on which the sod is turned can be used for potatoes. If the farm is divided into several parts all of the crops can be grown each year, the labor being well distributed. The general plan at present is to turn the sod in the spring, apply lime, and put in corn, followed with spring oats, winter wheat, clover, and timothy sown with wheat, leave in mowing until the timothy runs out, usually from three to five years. Buckwheat or potatoes may be substituted for corn, or frequently

the sod land is divided between these crops. This plan results in a rotation, but one which may be improved. The best farmers do not allow the timothy to run out before breaking the sod, but at three years plow and plant to timothy and clover again or to buckwheat, with rye and grass following.

At the present time the best types of reapers, binders, mowers, hayrakes, grain and fertilizer drills, disk and spring-tooth harrows and cultivators are in use throughout the county. The disk harrow is not as much used as the spring-tooth harrow, owing largely to the quantity of stone in the soils.

In a general way the crops adapted to the soils are as follows: Buckwheat, potatoes, and timothy do best on the Dekalb soils. Oats are known to do best on the Upshur silt loam. Wheat, bluegrass, and clover thrive upon the Upshur silty clay loam. The Dekalb soils are best adapted to apples and cherries. The glade land is well suited to the production of certain vegetables. The Huntington soils are considered best for corn, and the lighter types are best suited to melons and sweet potatoes. While the most decided difference between the Ligonier Valley and the southeast sections is in climate, the variation in the soils is responsible to some degree for the difference between these sections in crop adaptations. These crop differences are recognized throughout the county.

In general the labor on the farms is efficient. A total of \$68,473 was expended for labor in Preston county in 1909, as compared with \$43,900 expended in 1899. The wage scale varies with the distance from industrial centers. In the rural districts \$20 to \$25 per month with board is the usual price paid for labor. For day labor \$1 a day with board or \$1.25 to \$1.50 without board is paid. For special work, or during rush seasons, the wage per day is higher. The laborers in the coal mines and lumber camps receive higher wages than those on the farms. Very little farm labor is hired during the winter months, unless large numbers of cattle are wintered. The greater part of the work on the farms is done by the owner or renter and his family, with hired help when the crops are harvested.

The total acreage in farms has declined from 324,123 acres reported in the 1880 census to 295,289 acres in 1910. The area of improved land, however, has increased from 140,495 acres

in 1880 to 164,845 acres in 1910. The average farm in Preston county comprises 104.1 acres, of which on an average 58.1 acres is improved. Seventy-one per cent of the land area of the county is in farms, and 90.3 per cent of farms are operated by owners. Where tenanted the terms of the leases are varied to suit conditions and the contracting parties, but are usually based upon one-half of the field crops.

The prosperity of many parts of the county is largely due to the fact that farmers have disposed of the coal upon their farms and invested the proceeds in improvements.

The 1910 census gives the value of buildings in Preston county as \$1,857,810, of implements as \$412,437, and of live stock as \$1,857,813. The total value of land improvements is given as \$4,918,937.

SOILS.

Eleven distinct types of soil have been mapped in Preston county. These have been differentiated on the basis of color, texture, origin, topography, organic content, and drainage conditions. The types are grouped into series. The members of each series are different in texture, but they have the same range of color in the soil material, the same kind of subsoils, and are similar in origin and condition of drainage.

The soils fall naturally into two divisions, upland or residual soils and bottom-land or alluvial soils. The residual soils vary mainly on account of differences in the rocks from which they are derived, the extent to which they have been subjected to erosion, and in the abundance of rock fragments present. The alluvial soils differ principally in texture or character of the material as affected by drainage conditions.

The geological formations of the county entering into the formation of soils are given in the following diagram:¹

¹See West Virginia Geological Survey reports and U. S. Geological Survey, folios 82, 160, 28.

Geological Formations Giving the Residual Soils of Preston County.

Age.	Geological formation	Thickness	Composition.
		<i>Feet.</i>	
Carboniferous	Monongahela...	400	Gray shales and sandstones predominating, with thin beds of coal and limestone.
	Conemaugh.....	600-650	Pittsburgh coal.
	Allegheny.....	250-300	Gray and buff shales predominating, with sandstones, thin seams of coal, and limestone.
	Pottsville.....	250-350	Sandstones and gray shales; sandstones predominating. Upper Freeport coal.
	Mauch Chunk..	250-350	Hard, coarse-grained sandstones and conglomerates predominating.
	Greenbrier.....	300-600	Red shale, green shale, red sandstone, and thin strata of limestone.
	Pocono.....	100-200	Red shale, thin green sandstone; hard blue limestone predominating.
Devonian	Catskill.....	500-525	Hard sandstones and conglomerates predominating near top; gray shale predominating near bottom.
	Chemung.....	600-900	Red sandstone and red shale predominating, with gray and buff shales.
		900-1,200	Olive-green shales and thin sandstones.

The rocks of the region are thus seen to be sedimentary in origin. They thicken perceptibly from west to east. Subsequent to deposition they were bent into a series of low ridges or anticlines and shallow troughs or synclines. Since the bending or folding took place erosion has been at work, acting most vigorously on the anticlines. The younger rocks of the region have been entirely removed from the anticlines, while they still exist in the synclines, especially the more pronounced ones. In addition to this general erosion the whole region has been thoroughly dissected. All of the valleys are deep, narrow, and steep sided.

The Chestnut Ridge anticline is the most westerly of those that traverse Preston county. Like all the other anticlines, as well as the intervening synclines, it trends northeastward and southwestward. From the top of this anticline the rocks sink rapidly to the Ligonier syncline. The rocks rise again from the Ligonier trough to the Preston anticline, which is represented by a low range of hills running almost north and south through the county. From the crest of this anticline the rocks sink rapidly to the Kingwood syncline, where the formations reach one of the lowest levels in the county, and where the largest area, and seemingly the greatest thickness of the younger rocks of the area, occur. From the Kingwood syncline the rocks rise very rapidly to the Briery Mountain and

Etam anticlines, which represent the greatest of these uplifts. These two anticlines, though disconnected, lie in the same general line of strike, the latter lying considerably to the southwest of the former. These anticlines have both been severely eroded on account of their great elevations originally. Their ridge characters are, as a whole, lost, but there have been developed a pair of ridges, one the Briery Mountains and Laurel Ridge lying west of the anticlines, and Snaggy Mountain and Brushy Knobs on the eastern flank of the Briery Mountain anticline. The rocks exposed at the surface by the erosion of these anticlines include all the formations from the Chemung up to and including part of the Pottsville.

From the eastern crest the rocks sink rapidly to the Mount Carmel syncline, in which the rocks of the Conemaugh formation are exposed at the Maryland State line.

The rocks rise from the Mount Carmel syncline to the Deer Park anticline, on which the Chemung formation is again exposed. The Mount Carmel syncline rises rapidly at its southern end near Amboy and unites the outcrops from the Briery Mountain and Deer Park anticlines. Southeast of the Deer Park anticline the rocks sink rapidly, Backbone Mountain forming the eastern base of the Deer Park anticline. Map II shows the lines of anticlines and synclines of Preston county.

Over the greater part of the county the rocks of the Conemaugh formation constitute the surface outcrop. The dominant soil type, the Dekalb silty clay loam, which covers nearly all of the Ligonier Valley, is derived from this formation. The Briery Mountain, Etam, and Deer Park anticlines bring to the surface the rocks that form the Upshur silty clay loam and the Upshur silt loam.

The Upshur clay is derived from the Pittsburgh reds of the Conemaugh. This formation is not very extensive, and the type is developed only in the southwestern part of the county. Near the Pennsylvania State line the Pittsburgh reds appear again, but not in sufficient thickness to give rise to a soil type. The Upshur silt loam is derived from the red sandstones and red shales of the Catskill formation. It differs somewhat from the type as mapped in the western part of this State, but is probably similar to the typical soil. The Upshur silty clay loam is influenced to some extent by limestone, thin

beds of which are contained in the lower portion of Mauch Chunk shale. The Greenbrier limestone, however, is below the Mauch Chunk shale and is usually completely covered by wash from this formation. The Greenbrier limestone contains a large amount of red shale near the top of the formation, so that the group as a whole is composed of three-fourths red shale and thin red sandstone, the remainder being limestone with a small percentage of interbedded gray shale.

The Dekalb silty clay loam is derived from the formations above the Pottsville conglomerate. These formations are composed of alternate gray shale and sandstone. Where workable coal veins occur at no great distance from the surface which is above drainage, as is the case throughout much of this type, the moisture supply is materially decreased by removal of the coal, as the underground passage forms a perfect drainage way. Over such areas, after the coal is removed, crops suffer during dry seasons.

The Chemung formation, the lowest geologically in the county, is composed of gray and buff shale and thin sandstone. It gives rise to the Dekalb silt loam in large areas. The steeper slopes result in the Dekalb stony silt loam.

The Dekalb stony loam comes largely from the sandstones of the Allegheny, Pottsville, and Pocono formations. The fine soil material is in all probability derived from the shales of the overlying formations. However, these formations contain some interbedded shale. The large amount of conglomerate material in the type is the result of the weathering of the large number of conglomerate sandstones occurring in these formations.

Rough stony land is derived largely from the sandstones of the Allegheny, Pottsville, and Pocono formations. It occurs upon more level areas than have heretofore been encountered in the soil survey of West Virginia. Usually the Rough stony land occupies steep mountain sides or stream gorges, as along the Cheat River gorge in this county.

The Huntington silt loam is fairly typical of the soil as mapped in other areas. The material has been deposited by stream overflow, having been washed from the upland soils. The Huntington sandy loam was deposited by streams having swifter currents than those by which the Huntington silt loam

was laid down. The material has been washed to a greater extent from sandy upland soils. The Holly silty clay loam represents first-bottom overflow land which has been subjected to poorer drainage between overflows than the Huntington soils. The type occupies broad, flat bottoms through which the streams flow sluggishly and over which water stands after heavy rains.

The following table shows the origin of the various soil types:

Type.	Origin	Soil type.
Upland, or residual soils..	Grayish and yellowish shales, with some sandstone influence.	Dekalb stony loam, Dekalb silt loam.
	Grayish and yellowish shales, sandstone and conglomerate.	Dekalb stony loam, Dekalb stony silt loam, Rough stony land.
	Indian red shale, and sandstone chiefly.	Upshur clay, Upshur silt loam.
	Indian red shale, with some limestone influence.	Upshur silty clay loam.
Bottom, or alluvial soils...	Wash from upland shale, sandstone, and limestone soils.	Huntington silt loam, Huntington sandy loam, Holly silty clay loam (poorly drained).

The following table gives the names and extent of the soil types of Preston county:

Areas of Different Soils.

Soil	Acres	Per cent	Soil	Acres	Per cent
Dekalb silty clay loam...	149,568	36.2	Holly silty clay loam...	13,056	3.2
Rough stony land.....	123,968	30.0	Upshur silty clay loam..	12,416	3.0
Dekalb stony silt loam..	38,080	9.2	Huntington silt loam...	8,256	2.0
Dekalb silt loam.....	29,056	7.0	Upshur clay.....	2,688	.7
Dekalb stony loam.....	17,920	4.4	Huntington sandy loam.	2,112	.5
Upshur silt loam.....	15,680	3.8			
			Total.....	412,800	.....

Dekalb Silty Clay Loam.

The soil of the Dekalb silty clay loam varies in depth from 6 to 12 inches. It is a yellowish-brown to grayish-brown fairly

friable heavy silt loam to silty clay loam. In the lower portion the soil is a yellowish silty clay loam, more compact than the upper soil, yet fairly crumbly. The immediate surface material is not very compact and has an open structure where the content of organic matter is relatively high. Where proper methods of cultivation have been employed the soil is mellow. The subsoil is a yellow or yellowish-brown, heavy, crumbly silty clay loam to clay, which becomes heavier and more compact with depth. Throughout a large part of the type small quantities of sandstone and shale fragments are scattered over the surface and through both soil and subsoil. This is more noticeable where the type is derived from the lower lying strata of the Conemaugh formation, the sandstone of which is thick and hard, giving more unweathered material. The fragments are not large and are not present in sufficient quantities to interfere seriously with cultivation.

The most extensive developments of this soil occur in the broad synclines between Chestnut Ridge and the Laurel Ridge-Briery Mountains uplift. It is typically developed around Reedsville and Masontown and in the Bruceton Mills and Brandonville section. A small area occurs in the syncline on the eastern edge of the county extending from Corinth to the top of Shaffer Mountain. There are small, detached areas capping Laurel Ridge and Chestnut Ridge that have not been removed by erosion.

The Dekalb silty clay loam is derived from the weathering in place of the gray shales and sandstones of the Monongahela and Conemaugh formations. A greater part of the material comes from the Conemaugh, as there is very little Monongahela outcrop in the area. The heavy shales are predominant in the Conemaugh formation and give rise to a heavy soil type.

In general, the surface is comparatively smooth, the type occurring over low, well-rounded hills and gentle slopes. The greater part of it is suitable for cultivation.

The proper management of this type presents a difficult problem to the farmer. Owing to its heavy nature, the soil is very retentive of moisture, and it remains cold late in the spring. The soil should never be plowed while wet. The preparation of a seed bed of proper depth requires a heavy farming equipment. Plowing should be deep in order to increase

the moisture-holding capacity of the soil, and the surface should be mulched by thorough harrowing and shallow cultivation to conserve the moisture. When properly handled the type is very productive, but if the organic-matter supply is not maintained the yields decline. Over much of the type an inadequate supply of organic matter has resulted in low yields.

Liming is practiced to some extent, 40 to 60 bushels of burnt lime per acre usually being applied. It is considered best to make light applications unless large quantities of organic matter have been turned under or some other effort made to improve the type in this respect. Ground limestone would probably help the land, but its value, as compared with that of burnt lime on this soil, is not definitely known.

The crops grown are wheat, oats, corn, buckwheat, rye, potatoes, timothy, and clover. Wheat is grown quite extensively and produces from 10 to 30 bushels per acre. Oats are grown to a limited extent, producing 20 to 40 bushels per acre. Very little rye is sowed, and the yields are only moderate. Buckwheat is probably grown more extensively upon this than upon any other type in the area. Yields of 20 to 30 bushels per acre are obtained. Potatoes do well, producing 100 to 200 bushels per acre, and are grown to some extent over areas within reach of transportation. Corn produces about 15 to 45 bushels per acre. Hay averages about 1 to 2 tons per acre. Timothy does well and is grown largely for hay. Some redtop is grown. A large part of the type is used for producing hay, and large numbers of cattle are kept. Bluegrass does only fairly well and permanent pastures are confined to small areas. Pastures are usually included with the rotations. Clover does well over most of the type and is used extensively in rotations.

This soil is well adapted to apples, peaches, plums, and cherries, although very little fruit is grown. Small fruits do well, but are grown only for home consumption. Nearly all of the vegetables common to this section do well and are grown in home gardens, but are not produced commercially.

The topography of most of the type permits the use of labor-saving machinery, such as drills, sulky plows, disk harrows, cultivators, spraying apparatus, etc.

The Dekalb silty clay loam is naturally a strong type, and responds readily to good treatment. Plowing should be deep

but should be deepened gradually. Liberal quantities of organic matter should be turned under to improve the structure and moisture-holding capacity of the soil. The type includes many excellent orchard sites which should be utilized for apples and cherries. Potatoes should be more extensively grown. Crop rotations should be so planned as to include more leguminous crops. Clover constitutes the best soil improving crop, but where clover fails, hairy vetch may be substituted. Even when clover is grown, such crops as cowpeas, and vetch can be included in the rotation. They furnish good hay and increase the nitrogen content of the soil.

The present method of handling pastures on the type is probably the best, as a sod does not last for an indefinite time, as on some of the other soils. In order to provide a permanent pasture, applications of about 1 to 2 tons of lime per acre should be made. A heavy application of lime will continue effective for about 20 years. A top dressing of phosphatic slag is also recommended for sod land.

The natural forest growth consists largely of oak, chestnut, chestnut oak, hickory, and maple. The type seems well adapted to the sugar maple, large numbers of which are found in the northern areas.

Nearly all of the type is cleared and under cultivation. The price per acre varies from \$20 to \$50, exclusive of mineral rights. Near the towns land values are greater because of the more desirable location.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Dekalb silty clay loam:

Mechanical Analyses of Dekalb Silty Clay Loam.

No.	Locality	Description	Fine gravel.		Coarse sand.		Medium sand.		Fine sand.		Very fine sand.		Silt.	Clay.
			P. ct	P. ct	P. ct	P. ct	P. ct	P. ct	P. ct	P. ct	P. ct	P. ct		
221101	1 mile north of Reeds ville.	Heavy silt loam, 0 to 8 inches	1.3	1.9	1.1	4.1	7.8	57.0	26.7					
221102	Subsoil of 221101.....	Silty clay loam, 8 to 36 inches	1.2	2.4	1.6	3.9	4.8	44.5	41.6					

Dekalb Silt Loam.

The soil of the Dekalb silt loam consists of a pale-yellow to grayish silt loam which quickly passes into a yellow or pale-yellow, slightly more compact and heavier, friable silt loam. The subsoil is encountered at depths varying from 6 to 10 or 12 inches. It is a yellowish-brown to golden yellow, very heavy silt loam to light silty clay loam of a compact or slightly friable structure. The type usually contains a few sandstone and in many places shale fragments.

The largest areas of the Dekalb silt loam occur around Terra Alta, and in the southeastern part of the county south of Eglon. A large development occurs near Kingwood, and small detached areas are found in nearly all parts of the county.

Weathering has been deep in most places, the parent rock being found ordinarily at about 5 to 6 feet or even deeper. The soil material is derived from fine-grained sandstone and argillaceous shales. These shales occur largely in the Monongahela and upper part of the Conemaugh formations, and in the Allegheny and Chemung formations. Detached areas of the type are found along the outcrops of the Pocono sandstone formation.

This type is much more easily cultivated than the Dekalb silty clay loam. It forms a mellow seed bed when properly handled. It has a slight tendency to become droughty in dry weather, and crops suffer from lack of moisture during prolonged droughts. The addition of large amounts of organic matter would relieve this condition to some extent and enable the soil to retain sufficient quantities of moisture to withstand droughts. The type responds readily to liming but its productiveness can not be maintained solely by this practice. Commercial fertilizers high in potash should be used where liming has been practiced extensively, even where manures have been used and the sod turned under.

The crops grown are Irish potatoes, buckwheat, oats, corn, wheat, rye, and some hay. Irish potatoes do exceptionally well on this soil, yielding from 150 to 250 bushels per acre. They are grown mainly on areas of the type nearest to transportation lines. Wheat, oats, and corn do well when fertilized, but make only fair to poor yields otherwise. Buckwheat yields from 30

to 35 bushels per acre. It is a good crop for the type and is grown quite extensively. The soil is not very well adapted to timothy and clover, of which only moderate yields are obtained. About three-fourths ton to one and one-half tons per acre of hay is produced. Cowpeas and vetch are the leguminous crops that seem best adapted to the type. Vetch is probably best suited to the climatic conditions of the area, and should be used in rotations where clover does not do well.

The Dekalb silt loam is one of the best fruit soils in the State. Owing to the level to gently rolling topography the type is well suited to commercial orcharding, and its high elevation insures good air drainage and lessens the danger of frosts. The type is particularly adapted to apples. The trees are usually healthy and long lived. Other fruits do well, such as peaches, plums, and cherries, also small fruits, blackberries, and raspberries. Grapes do fairly well, but are only grown to a very small extent. It is upon the Dekalb silt loam that most of the orchard development around Terra Alta has been made.

The natural forest growth consists largely of chestnut and chestnut oak, with smaller amounts of hemlock, pine, oak, hickory, walnut, and maple. The type is known locally as "chestnut land," "light land," or "sandy land." Most of it is cleared and under cultivation. Land values range from \$20 to \$60 an acre.

The results of the mechanical analyses of samples of the soil and subsoil of this type are given in the following table:

Mechanical Analyses of Dekalb Silt Loam.

No.	Locality	Description	Fine gravel.		Coarse sand.		Medium sand.		Fine sand.		Very fine sand.		Silt.	Clay.
			P. ct	P. ct	P. ct	P. ct	P. ct	P. ct	P. ct	P. ct	P. ct	P. ct		
221105	Manown	Silt loam, 0 to 10 inches.	0.1	1.0	1.2	11.4	22.9	45.9	17.4					
221106	Subsoil of 221105.....	Heavy silt loam, 10 to 36 inches.	.4	1.2	1.2	11.0	25.0	37.8	23.3					
221111	5 miles south of Aurora	Silt loam, 0 to 10 inches.	1.0	1.9	1.2	3.0	4.6	64.2	23.9					
221112	Subsoil of 221111.....	Silty clay loam, 10 to 36 inches.	1.4	4.0	1.9	2.5	3.0	59.6	27.4					

Dekalb Stony Loam.

The soil of the Dekalb stony loam varies considerably in texture, ranging from a gravelly sandy loam to heavy loam.

The type consists mainly of a gray to yellowish-brown loam, underlain at varying depths, usually at about 4 to 8 inches, by a yellow, silty loam of quite friable structure. This usually grades below into a yellow heavy loam to silty clay loam. The immediate surface soil is often dark gray, owing to the abundance of organic matter from leaf mold. In places the soil varies to a yellowish silty clay loam, while in other areas it has the texture of a sandy loam, but these places were too small or too irregularly distributed to be satisfactorily mapped. Much of the type contains large quantities of rounded quartz pebbles, which were carried by the conglomerate rocks from which the type is largely derived. Small and large sandstone fragments are scattered over the surface and disseminated throughout the soil mass. Shale is also frequently present. Some of the type is so stony as to approach closely the characteristics of Rough stony land, and small areas of Rough stony land are included. In general, however, this type is much less stony than Rough stony land, and is better suited to grass and fruit culture. It includes a much larger area than can be cleared of stones and brought under cultivation. The parent rock is usually encountered at about 18 to 24 inches below the surface. In many places the quartz pebbles are missing and the sand content is low. The stone content within the 3-foot section in many places constitutes 30 to 50 per cent of the entire soil mass. These fragments interfere materially with cultivation. In many places large quantities of rock have been removed from the surface and piled in the field or used in building fences. Rock outcrops are common on the steeper slopes, but cover relatively small areas.

The type is confined chiefly to rather steep slopes, and much of it, even if the rocks were not present, could not be safely plowed, as erosion would undoubtedly ensue. The drainage is usually good, but in many places, where sandstone strata underlie the type, it is poor. In such places crops are very likely to suffer from lack of water during droughts as the soil is too shallow to retain an adequate supply of moisture.

The soil is derived from coarse-textured, hard sandstone formations and shales. It usually occurs along the outcrops of the Pocono sandstone, Pottsville conglomerate, and the sandstones of the Allegheny formation.

A very small part of the type is cleared and under cultivation. Most of the cleared area is devoted to pasture. Some fair crops of corn, potatoes, wheat, oats, rye, buckwheat, and hay are secured, but for the most part the type is too rough for the use of improved implements and is best adapted to grazing or to crops that can be cultivated largely by hand. Corn, potatoes, buckwheat, grass, and fruit are the crops probably best suited to the type. Vegetables do well, especially cabbage, but are grown only for home consumption. They can be profitably produced on areas of the type within reach of markets. Plowing is difficult, and over much of the type harrowing is impossible. Where the stones are not too large, a spring-tooth harrow is used. Grass does not grow everywhere to the best advantage, but in general grazing is about as profitable as any other kind of farming. A large number of sheep are raised on this land.

The Dekalb stony loam can be successfully utilized for orchards. Several commercial orchards have been started and are in a flourishing condition. Apples and peaches do best. It may be necessary to use dynamite in preparing the land for fruit trees, as the rock substratum in places will interfere with the proper development of the root system. Small fruits do well and can be grown to advantage.

Where the soil is derived from the Pocono sandstone, which underlies the "Big Lime," the type is more productive than in other places. Material from the limestone formation has probably influenced the type considerably. These more productive areas are known locally as "good stony land" to distinguish them from stony land of lower agricultural value. Over nearly all of this phase of the type the stone has been removed and used in fence building, and the farms have a prosperous appearance.

The natural forest growth consists largely of white pine, spruce pine, and hemlock on the east side of the mountain, and mainly chestnut and chestnut oak on the west side, with a

sprinkling of other trees, such as the other oaks, hickory, walnut, and maple. Hazel brush, blackberry bushes, mountain laurel, ferns, and moss are conspicuous in places. The land is valued at \$10 to \$30 an acre.

The following table gives the results of mechanical analyses of fine-earth samples of the soil and subsoil of the Dekalb stony loam:

Mechanical Analyses of Dekalb Stony Loam.

No.	Locality	Description	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
			<i>P. ct</i>	<i>P. ct</i>	<i>P. ct</i>	<i>P. ct</i>	<i>P. ct</i>	<i>P. ct</i>	<i>P. ct</i>
221123	One-half mile south of Howesville.	Loam, 0 to 8 inches	3.1	4.3	2.4	4.6	8.9	53.9	22.7
221124	Subsoil of 221123.....	Heavy loam, 8 to 24 inches	2.4	4.3	2.5	4.7	7.1	53.3	20.6

Dekalb Stony Silt Loam.

The Dekalb stony silt loam contains a large quantity of sandstone fragments, varying in size from small, angular pieces to boulders several feet in diameter. A large number of flaggy fragments, varying from about 6 inches to a foot square and several inches in thickness, are scattered over the surface of the type. Shale chips are also present. The fine soil material of the surface portion is a yellowish-brown to grayish-brown, mellow silt loam, averaging about 8 inches in depth. The subsoil consists of a yellow to yellowish-brown heavy silt loam to silty clay loam containing about the same proportion of sandstone fragments as the soil. In many places the parent rock is encountered within the 3-foot section, but it seldom occurs at depths of less than 2 feet. A few narrow rock ledges outcrop in the type, but these are too small to be shown on the map. In a few places the type contains a large amount of sand. These spots are small and the sand content is not high enough for the soil to be classed as a sandy loam. This type is some-

what similar to the Dekalb stony loam, except that it usually contains less stone, and the soil material is heavier.

The Dekalb stony silt loam usually occupies comparatively steep slopes.

The soil is derived from the sandstone and shales of the Conemaugh, Allegheny, Pocono, and Chemung formations. The Allegheny and Chemung formations give rise to most of the type. Where the type is derived from the Allegheny formation the fine earth comes largely from the overlying shale formations. The Chemung formation consists largely of shales.

Owing to the uneven topography, the drainage is usually good. Notwithstanding the steep topography, the type is fairly retentive of moisture. The rocks prevent rapid evaporation and assist in holding the supply of water which seeps in from higher ground. This capacity to hold moisture renders the type better fitted for crop production than might be expected from such steep, rough land. Cultivation is difficult. The type is recognized as fairly good grazing land and is used to some extent for that purpose. Grass holds and lasts well, even during droughts. Sheep raising is probably more profitable than the raising of any other live stock. Farm machinery can not be successfully used, and crops must be cultivated largely by hand. Spring-tooth harrows are used where the rocks are not too numerous. In many places the rocks and the topography preclude the use of reapers and binders. This prohibits the production of such grains as wheat, oats, and buckwheat. Buckwheat is grown more extensively than any of the other cereals and produces fairly good yields. In some cases the fields are cleared of the rocks, which are either piled in the field or used for building fences. The fields can then be cultivated with comparative ease, but the removal of the rocks involves considerable labor. Corn is probably the most profitable of the intertilled field crops. Potatoes and tomatoes can be profitably produced. Vegetables are grown in small patches, as hand cultivation is usually practiced in the case of garden crops.

The type is well adapted to fruit. The trees make a healthy growth and the fruit has good color, but most of the type is not suited to commercial orcharding because of its topography. Many small apple orchards have been established

and are in a flourishing condition. Small fruits do well and should be more generally grown.

The producing power of this soil is about equal to that of the Dekalb silt loam where the same attention is paid to the preparation of the soil and to cultivation. Generally, however, the system of agriculture practiced on the type does not include proper preparation or thorough cultivation. Since very few cereals are grown, fertilizers are used to only a small extent. Stable manure is generally used on vegetables or corn. Very few leguminous crops are grown.

Much of the type is still in forest, and the rougher portions should be allowed to remain forested. The timber growth consists mainly of oak, chestnut, chestnut oak, walnut, hickory, ash, beech, and maple in the Ligonier Valley, and spruce pine, white pine, and hemlock with a scattering of other trees in the country to the southeast of the Laurel Ridge-Briery Mountains chain.

The Dekalb stony silt loam has about the same value as the stony loam type.

In the following table the results of mechanical analyses of fine-earth samples of the soil and subsoil of this type are given:

Mechanical Analyses of Dekalb Stony Silt Loam.

No.	Locality	Description	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
			P. ct	P. ct	P. ct	P. ct	P. ct	P. ct	P. ct
221125	1 mile east of Irona....	Stony silt loam, 0	1.0	4.0	3.1	6.0	6.6	57.3	21.9
		to 8 inches							
221126	Subsoil of 221125.....	Heavy silt loam, 8	1.5	3.3	2.9	5.2	5.1	57.3	24.6
		to 36 inches							

Rough Stony Land.

The Rough stony land in Preston county comprises steep stony land which has little or no agricultural value. Many rock outcrops and steep rocky cliffs occur throughout the type. The soil material ranges from yellowish silt loam to grayish

sandy loam belonging mainly to the Dekalb series. In a few places Upshur material is found. Throughout the entire type small areas are found which could be cultivated with a fair degree of satisfaction, provided the surface were cleared of the larger stones. Over a large part of this land, however, the stones are too large to remove, and bedrock is encountered near the surface. Yet there is enough soil material even in much of this rough portion to support grass for fair grazing. By far the greater part of the type should be allowed to remain in forest.

The Rough stony land is located mainly along the Cheat River gorge and tributary streams, and upon the eroded slopes of Briery Mountains, Laurel Ridge, and Chestnut Ridge.

It is derived largely from outcrops of the Pottsville and Pocono formations, which are composed of hard sandstone and conglomerates. Where these formations outcrop the Rough stony land frequently occurs, even in level areas. Throughout the Cheat River gorge the soil is derived from nearly all of the formations found in its profile. Where the soft shale formations outcrop in steep places, boulders from the overlying sandstone formations are scattered over the surface.

Aside from its timber, coal, and such stone as may be suitable for building and other commercial purposes, a large part of the type has little value. The natural forest growth consists mainly of spruce pine, hemlock, white pine, oak, chestnut oak, and chestnut, with some hickory, walnut, beech, ash, hazel, and maple. The type can be utilized to a small extent for grazing sheep and goats.

Upshur Silt Loam.

The Upshur silt loam is a dark reddish brown to Indian-red, friable silt loam, underlain at about 10 to 12 inches by Indian-red silty clay loam, which in turn grades at about 24 to 30 inches into Indian-red clay loam or clay. Both soil and subsoil contain large quantities of small sandstone and shale fragments. These fragments are usually Indian-red in color and are merely the partially weathered fragments of rocks from which the soil is derived. A few yellow sandstone fragments occur. The sandstone and shale fragments are never sufficiently large or numerous to interfere with cultivation. The soil is

fairly deep. In only a few places is the parent rock encountered within the 3-foot section. Even upon the steep slopes the soil is deeply weathered.

The Upshur silt loam occurs in an interrupted belt along the line of outcrop of the Catskill formation, extending from the southern boundary of the county along the low hills to the east of Laurel Ridge and along a low range of hills to the east of Briery Mountains to near Dority, where it makes a horse-shoe bend and passes southwest slightly to the east of Terra Alta. On the hilltops near Erwin it becomes a broad, flattened fan, passing out of the county just south of the point at which the Youghiogheny River crosses into Maryland. Another narrow strip extends along the low range of hills following the western base of Backbone Mountain.

The type is derived mainly from the red shales and red sandstones of the Catskill formation. A few thin strata of buff and gray shales and gray sandstones occur in this formation, but have very little influence upon the soil. Where Rough stony land is associated with outcrops of this formation, as along the Cheat River gorge and tributary streams in the southern part of the county, the rock fragments present usually come from overlying sandstone formations.

The topography of the type in general is gently rolling to rolling, except where it is traversed by stream gorges, in which case the slopes are decidedly steep. Drainage is well established, on account of the topography, the loose structure of the soil and subsoil, and the porous nature of much of the underlying strata. Most of the type lies above the 2,000-foot contour.

The crops grown are oats, corn, buckwheat, potatoes, wheat, clover, and timothy. The type is probably best adapted to oats. A large acreage is devoted to this crop, and the yields are heavy. Potatoes yield 100 to 150 bushels, hay $1\frac{1}{2}$ to $2\frac{1}{2}$ tons, wheat 15 to 20 bushels, buckwheat about 20 to 25 bushels, and corn about 40 to 50 bushels per acre. Buckwheat does not do quite as well as on this type as upon the Dekalb soils. This is also generally true of fruits. Small fruits do fairly well. Such vegetables as cabbage, kale, etc., produce good yields. Clovers and leguminous crops do exceptionally well, especially where liming is practiced. Hairy vetch is not grown, but is

well adapted to soils of this character and could be used to advantage in crop rotations. Oats and vetch combined could be profitably grown.

The lime content of this type is low and applications of this material should prove beneficial. An adequate supply of organic matter and good plowing puts the soil in excellent condition.

This soil is often confused with the strip of soil derived from the Mauch Chunk shale and Greenbrier limestone, the Upshur silty clay loam, which is much heavier and requires different treatment. The Upshur silt loam is not so strong as the silty clay loam type and is in need of fertilizer when heavy cropping is practiced. Fertilizers high in phosphorus and potash should be used, and leguminous crops should be grown to supply nitrogen.

Owing to the friable texture of the soil a seed bed is easily prepared, and subsequent cultivation is not difficult. A large acreage is devoted to intertilled crops. Bluegrass does fairly well, but only a small part of the type is in permanent pasture. Timothy makes good yields, and a small area is devoted to this crop. Nearly all the type is cleared and under cultivation. Even the steep slopes of the type are put in corn or grass.

The natural timber growth includes chestnut and chestnut oak, with a scattering of other oaks, hickory, walnut, locust, and maple. The type is known locally as "red chestnut" land, and is valued very highly as an agricultural soil. It is held at \$60 to \$100 an acre.

The results of mechanical analyses of samples of the soil and subsoil of the Upshur silt loam are given in the following table:

Mechanical Analyses of Upshur Silt Loam.

No.	Locality	Description	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
221113	1¼ miles south of Aurora	Silt loam, 0 to 12 inches	<i>P. ct</i> 0.0	<i>P. ct</i> 1.8	<i>P. ct</i> 1.1	<i>P. ct</i> 5.6	<i>P. ct</i> 15.2	<i>P. ct</i> 57.1	<i>P. ct</i> 19.1
221114	Subsoil of 221113.....	Silty clay loam, 12 to 36 inches	1.0	2.0	1.1	5.7	16.1	48.5	25.5
221121	2 miles south of Terra Alta	Silt loam, 0 to 8 inches	.4	2.0	1.2	8.2	18.7	50.7	18.7
221122	Subsoil of 221121.....	Silty clay loam, 8 to 36 inches	1.6	3.0	2.2	8.1	16.1	45.1	23.0

Upshur Clay.

The Upshur clay consists of a reddish-brown to Indian-red silty clay loam to clay loam or clay, underlain at about 3 to 5 inches by an Indian-red, heavy, plastic clay, which becomes slightly heavier and more compact with depth. In some places the surface soil is grayish in color. The soil is deep, as is the case with nearly all soils derived from soft shales. In places a few rocks are scattered over the surface.

The type occurs usually in narrow strips on hillsides. In only a few places does it appear on the tops of the hills. The surface is usually steeply sloping, and the drainage is good.

The Upshur clay is derived from Indian-red and green shales of the Conemaugh formation. This type is confined to the southwestern corner of the county where these shales are thicker and more intense in color. Over other parts of the area the formation is either eroded or runs to gray and yellow shales.

The type is essentially the same as has been mapped in other areas in West Virginia, with the possible exception of a slightly lower lime content. The shales from which the soil is derived seem to be only slightly calcareous, as is indicated by the lack of lime concretions in the outcrops, although the soil contains enough lime to produce good crops of bluegrass and leguminous plants.

The Upshur clay is very hard to bring into cultivation in the spring. Its tenacious character renders it very retentive of

moisture. It remains cold and damp longer in the spring than most of the other types in the county. When dry the soil bakes hard and cracks, which is characteristic of most clay soils. Clods formed by plowing when the land is too wet are very difficult to pulverize. The cultivation of a soil of this character requires a heavy farm equipment and the land should be thoroughly prepared by repeated harrowing to secure the proper seed-bed condition. Fall plowing is recommended where early spring planting is to be done. This will allow the soil to mellow under the influence of alternate freezing and thawing during the winter season.

Large areas of this type should be kept in permanent pastures or devoted to the production of hay. Cultivated crops should not be grown too frequently, especially on the slopes, owing to the danger of erosion.

The crops grown are wheat, oats, corn, buckwheat, potatoes, clover, timothy, and bluegrass. Wheat and corn probably cover a larger acreage than any of the other cereals. A fair acreage is devoted to clover and timothy. Buckwheat is not grown as extensively as upon the Dekalb soils. This type is not especially adapted to fruits, but a large number of home orchards are found in which fruit does fairly well. Potatoes are not grown on a commercial scale, but represent the most important garden crop. Many different vegetables are grown successfully in kitchen gardens. The soil is well suited to bluegrass and by far the larger part of the cleared portion is in bluegrass pasture. The sod lasts indefinitely if properly cared for. This type affords excellent grazing for steers, and stock raising is the most profitable business that can be carried on upon the type.

Corn produces 30 to 40 bushels, wheat 10 to 20 bushels, oats 20 to 30 bushels, and hay $1\frac{1}{2}$ to 2 tons per acre. Timothy suffers in dry weather from the baking of the surface soil.

The use of manure, the turning under of cover crops or sod, and liming will improve the physical condition of the soil. Very little fertilizer is used. Bone meal and phosphates are used on wheat. Liming is practiced to some extent, and some farmers turn under a sod occasionally.

The Upshur clay is not very extensively developed in this

county. It is nearly all cleared and under cultivation or in permanent pasture. The natural forest growth is largely oak, hickory, maple, walnut, locust, and beech. The type is valued at about \$30 to \$40 an acre.

Upshur Silty Clay Loam.

The Upshur silty clay loam as typically developed is a brown to dark reddish-brown mellow silty clay loam, underlain at 8 to 12 inches by a reddish-brown to Indian-red, compact and moderately friable silty clay to clay loam. Very few of the rock fragments present are derived from the parent rock. Rocks from the next higher formation (Pottsville conglomerate) in the geological column are quite abundant along the upper margin of the soil areas.

Both surface drainage and underdrainage are good. In a few places along the lower slopes adjoining stream bottoms narrow strips are kept wet by seepage water. The soil in such places is heavier, more tenacious, and yellowish-brown in color. These spots are very small and could not be separated upon a map of the scale used in the present survey.

A strip of the Upshur silty clay loam is developed over the eastern face of Laurel Ridge and Briery Mountains, passing out of the county at Cranesville. Another strip enters the county along the western base of Snaggy Mountain and extends southwest to Amboy, where it passes around the base of Brushy Knobs and leaves the county along the base of Shaffer Mountain. Nearly all of the type is over 2,500 feet above sea level. It occupies hillsides and as a rule the surface is steeply sloping. Around Aurora it is smoother than elsewhere in the county.

The soil is derived from the weathering of the red shales and red sandstones of the Mauch Chunk formation with some local influence from the Greenbrier limestone. Colluvial material from the Mauch Chunk shale has covered the soil derived from the limestone. In the few places where the limestone formation influences the soil the subsoil has a yellowish-red color and is usually heavier and more plastic than the average. The parent rock is ordinarily encountered at depths of 4 to 8 feet or more beneath the surface.

The type remains cold rather late in the spring. Fall plowing is advisable in order to subject the upturned soil to the beneficial action of freezing and thawing. The results from plowing while too wet are not as serious as might be expected upon such heavy soil. If cultivated when moderately moist a mellow seed bed is easily prepared.

The Upshur silty clay loam is probably the best soil in the county. It produces good yields of wheat, oats, corn, buckwheat, potatoes, clover, and timothy without the use of commercial fertilizers. Wheat is one of the most profitable crops grown, and covers a large acreage. Corn produces better yields than upon any other upland type in the county. The type is not especially adapted to buckwheat, but this crop is grown to some extent. Oats do fairly well, the yields being somewhat lower than on the Upshur silt loam. Clover does exceptionally well and is sowed alone more extensively upon this type than on any other in the county. Timothy gives heavy yields, and does not deteriorate as quickly as upon some of the other types. Potatoes yield well, though the soil is not so well adapted to this crop as the Dekalb soils. The yield is much more uncertain and the quality is not quite up to the standard. Wheat on the best managed farms produces about 30 bushels per acre. Bluegrass does better than upon any other type in the county, and large areas are in permanent pasture. Large numbers of cattle, horses, and sheep are raised and fattened for the market. Such vegetables as cabbage, kale, beans, etc., make good yields, but the soil is not especially adapted to truck crops, as it remains cold probably later than any other soil type in the county. It is not quite so well adapted to fruits as the Dekalb soils.

Very little fertilizer is used. Small applications of phosphate or bone meal are used for wheat when this crop precedes grass. Liming is practiced to a small extent. While the type is known locally as "limestone land," the surface soil of most of the type contains very little lime, although the lime content of this soil is higher than that of any other type in the county. Many farmers have never used commercial fertilizer or lime on the soil, but grow clover and turn under a sod about every 4 or 5 years and thus maintain the fertility of the soil.

Nearly all of the type has been cleared of the native forest

growth, which consisted largely of oak, hickory, maple, walnut, ash, and locust. It is valued at about \$100 an acre.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of this type:

Mechanical Analyses of Upshur Silty Clay Loam.

No.	Locality	Description		Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
				P. ct	P. ct	P. ct	P. ct	P. ct	P. ct	P. ct
221115	One-fourth mile north of Carmel.....	Silty clay loam, to 12 inches	0	0.6	2.4	1.3	5.0	5.0	59.5	26.0
221116	Subsoil of 221115.....	Silty clay loam, to 36 inches	12	.6	3.1	1.9	4.9	5.4	53.8	30.1
221119	3 miles west of Terra Alta	Heavy silt loam, to 10 inches	0	2.2	3.6	1.8	6.0	10.0	53.6	22.6
221120	Subsoil of 221119.....	Silty clay loam, to 36 inches	10	1.2	3.2	1.6	5.6	7.2	50.5	30.6

Holly Silty Clay Loam.

The soil of the Holly silty clay loam consists of a dark-gray or drab to grayish-brown, slightly plastic heavy silt loam to silty clay loam, faintly mottled in the subsurface portion with shades of brown. At about 10 to 12 inches the soil passes into a subsoil of heavy silty clay loam to silty clay of a mottled yellowish brown and drab color. In poorly drained spots the mottling shows bluish and rusty brown colors. Black oxide of iron material is present in such places. A large proportion of the type is water logged below a depth of 24 to 30 inches.

In places where the organic content is high the soil to a depth of a few inches is dark to almost black. This condition is more often found in uncleared areas. Where the type receives wash from the Dekalb and Upshur soils there is present along the outer edges a mantle of brownish material which varies in thickness. In a few places near outcrops of sandstone the sand content is relatively high, but such areas are small.

The type is most extensively developed around Reedsville, Terra Alta, and Glade Farms. Detached areas are found in nearly all parts of the county.

This is an alluvial soil subject to overflow. Portions of the type lie a little above normal overflow.

The topography is level to very gently sloping toward the stream channels. The streams follow meandering courses through the type, frequently dividing into numerous channels. In many places in the center of the glades or along the streams strips of swampy land are found whose drainage is difficult. Drainage can be established over most of the type, however, without any serious trouble from lack of fall. Some of the land has been drained by open ditches, the main channels of the streams having been straightened and enlarged. The sloping areas are usually plowed into "lands" varying from 10 to 20 feet wide with the "dead furrows" running with the direction of the slope. A very small part of the type has been tile drained.

The native growth on the glades in the Ligonier Valley region is largely alder and willow, while in the more elevated southeastern section of the county it consists of alder and pine. Mosses and ferns flourish in the uncleared areas. Bulrush is common on the pastures of the cleared portions. The early settlers found cranberries growing wild over these bogs, and they are very often referred to as "cranberry bogs." The term "crawfish" land is also used, although "glade land" or "glades" is the name most commonly applied to such areas.

After drainage, heavy applications of lime should be made to correct the acidity or other unfavorable conditions of the soil. Under present conditions the type would require a great amount of lime for that purpose. The soil is cold and clammy and can not be brought into good tilth until late in the spring. This is due in part to the poor drainage conditions and partly to the heavy texture of the subsoil.

The greater part of this soil contains sufficient organic matter for the production of most crops, but it probably is not in the most favorable condition. The material is generally in need of aeration. Care should be taken to cultivate the type while in the proper condition with respect to content of moisture. Otherwise clods will form, and, on drying, the soil will assume an unfavorable, hard structure.

Very little of the type is cleared and under cultivation, and much of the cleared portion is in permanent pasture. Corn

and timothy do fairly well, but such crops as wheat, oats, and rye have a tendency to produce too much stalk, and are grown to a very small extent. Buckwheat does fairly well and is grown more extensively than any other crop. The yield of this grain averages about 30 bushels and of corn about 40 to 60 bushels per acre. Potatoes make good yields on the better-drained portions of the type. Such vegetables as cabbage, cauliflower, kale, onions, lettuce, celery, tomatoes, beans, and squash do well and can be grown profitably. Of these, the type is best adapted to cabbage, onions, and celery, and large yields of these crops can be obtained. The type can not be recommended for early truck crops on account of its heavy, cold nature. Large yields of late truck crops can be secured. A series of experiments has been conducted by the West Virginia experiment station to determine the vegetables and the varieties best suited to this type.¹

Liming and manuring are practiced to some extent. Very little commercial fertilizer is used. In growing truck crops, fertilizers of high grade should be liberally used. Fertilizers, however, are of little benefit unless the proper drainage is provided.

The type furnishes good, succulent pasture during the dry seasons of the year, and on this account dairying should prove profitable. The type is not very well suited to leguminous crops. Alsike will do fairly well on the better-drained areas. Blackberries, raspberries, and strawberries do well, especially the latter. The type can not be recommended for fruits on account of its low position.

This soil is not valued as highly for agriculture as it should be, and its producing power is not appreciated. The land is held at \$50 to \$100 an acre.

Huntington Silt Loam.

The soil of the Huntington silt loam is a dark-brown, mellow silt loam about 10 inches deep. The subsoil is a yellowish-brown, heavy, slightly compact, and friable silt loam, becoming somewhat lighter in color and in texture and less compact as

¹See Bulletin No. 81, West Virginia Expt. Sta.

depth increases. A few fragments occur on the surface and throughout the soil mass.

The type occupies first bottom or overflow land along streams, which receive the wash from the uplands. The surface is nearly level to slightly undulating, the latter configuration being due to the presence of swells and swales such as are common to many portions of the stream bottoms. The swales are very narrow and usually occur near the hills. They are usually poorly drained and represent more nearly the condition of the "glade lands." The subsoil in such places is heavy and more or less mottled with gray. These swales should be tile drained.

A few strips are found in some places, as in Dunkard Bottom, along the edge of the larger streams, where the sand content is high and the subsoil is reddish. The soil in such places approaches the characteristics of the Moshannon fine sandy loam, but the areas are too small to map separately.

The type occurs at 5 to 30 feet above the normal level of the streams, and the drainage is generally good.

The soil is easily cultivated, and only a light draft is required in plowing. A mellow seed bed may be established with but little harrowing. Labor-saving machinery can be used to advantage.

The crops grown are corn, oats, wheat, buckwheat, potatoes, clover, and timothy. Corn is grown more extensively than any other crop and yields from 50 to 60 bushels per acre. Wheat, oats, buckwheat, and potatoes are grown most extensively on the higher-lying areas. These areas are subject to occasional overflow, yet there is little danger of losing a crop upon the high bottoms, such as Dunkard Bottom. Wheat and oats do well, but have a tendency to lodge. Buckwheat gives good yields. Potatoes yield from 150 to 200 bushels per acre. Timothy makes splendid yields and is well adapted to the type. Alsike does well and is used quite extensively. It takes the place in the rotation filled by crimson clover on the upland. The growing of cowpeas, soy beans, or vetch has never been practiced, but these crops could be grown with profit. Sweet potatoes, peanuts, sorghum, and melons are well suited to the type, but are grown to only a small extent. The type is a good trucking soil. It is well adapted to cabbage, kale, turnips,

cauliflower, spinach, onions, beets, tomatoes, sweet corn, lettuce, and celery. Pumpkins and squash do exceptionally well. Conditions are not favorable for fruits. The air drainage is poor and the crop is likely to be injured by frost, and saturation of the soil during overflows would be injurious to the trees. Blackberries, raspberries, and strawberries should do well over those portions of the type subject to only occasional overflow.

The Huntington silt loam is practically all cleared and under cultivation. The original forest growth consisted largely of sycamore, elm, gum, ash, beech, birch, and willow. The type is valued at about \$100 an acre.

Huntington Sandy Loam.

The soil of the Huntington sandy loam is a dark-brown to yellowish-brown, mellow, light sandy loam about 6 to 8 inches deep. The subsoil is a brownish-yellow, fairly loose and open light sandy loam. The sand content increases with depth. In many places beds of sand or gravel, consisting mainly of sandstone fragments, are encountered at 24 to 30 inches.

The type forms a mellow seed bed. When dry the soil is loose and open, and it packs slightly when wet. Cultivation is easily accomplished. The soil is slightly droughty, especially in the higher areas. The topography is level to slightly undulating, and the drainage between overflows is good.

The Huntington sandy loam is used largely for meadow and the production of corn, oats, and buckwheat. Only fair yields of these crops are obtained. Such crops as cowpeas, soy beans, and vetch should do well. Both sweet and Irish potatoes give good results, the soil probably being better adapted to sweet potatoes. Nearly all of the vegetables common to the region do well where grown in gardens, and the production of truck crops on a commercial scale should receive greater attention. Owing to its sandy nature the soil has a tendency to mature crops earlier than other soils, and it can be handled earlier in the spring. Such vegetables as lettuce, onions, turnips, beans, and beets do well. Pumpkins and squash also thrive upon this soil. Melons also do well. Timothy does not

produce as large yields as on heavier soils, and the type is better suited to redtop.

The plowing under of such crops as rye, vetch, and cow-peas would result in the improvement of the land.

Nearly all of the Huntington sandy loam is cleared and under cultivation. The natural forest growth is sycamore, elm, birch, and beech. The land is valued at about \$15 an acre.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Huntington sandy loam:

Mechanical Analyses of Huntington Sandy Loam.

No.	Locality	Description	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
			P. ct	P. ct	P. ct	P. ct	P. ct	P. ct	P. ct
221107	1½ miles east of King-wood	Loamy sandy loam, 0 to 7 inches	0.2	4.7	15.3	34.2	17.2	18.4	10.1
221108	Subsoil of 221107.....	Light sandy loam, 7 to 36 inches	.2	11.4	29.2	37.5	9.5	7.6	4.3

SUMMARY.

Preston county lies in the northern part of West Virginia, bordering Pennsylvania and Maryland. It comprises 412,800 acres, or 645 square miles.

With the exception of the deep gorge cut by Cheat River and the Laurel Ridge-Briery Mountains range, the county presents a fairly even surface for a mountainous country. The area is divided into two physiographic sections by the crest of the Laurel Ridge-Briery Mountains range. The country to the north and west of this line, comprising about three-fourths of the county, is known as the Ligonier Valley, and southeast of the line consists of a more elevated plain deeply dissected with high ridges and mountain peaks and relatively broad intervening valleys. These two sections have a difference in general elevation of about 1,000 feet.

The first settlements were made in the county about 1770. After the Revolutionary War large numbers of settlers came

into the county from Maryland, Pennsylvania, and Virginia. Preston county was formed in 1807.

Between 1820 and 1850 many roads and turnpikes, including the Northwestern Virginia Turnpike, were constructed. The building of these roads gave great impetus to the internal development of the county. The Baltimore & Ohio Railroad, passing through Preston county, was completed in 1852. An era of progress followed the completion of this road, as means of transportation for products was assured, and additional pikes and roads were built to connect with points along the railroad. The Morgantown & Kingwood Railroad, completed in 1906, opened a good farming and mineral section. Since the early settlement of the county the principal markets have been Baltimore and Pittsburgh.

The two physiographic sections of the county differ to some extent in climatic conditions, but in general the climate is mild and healthful. The summers are short and comparatively cool, and the winters, while cold, are not rigorous. In the higher country the season is about two weeks later in the spring. This section is not entirely free from the possibility of frost at any time of the year, and frosts severe enough to kill wheat have occurred as late as June. The mean annual precipitation at Terra Alta is 56, and at Rowlesburg 44 inches. These stations represent the Ligonier Valley and the country to the southeast of Laurel Ridge-Briery Mountains chain.

Corn was the first crop grown in the county. This was followed by wheat, and by 1820 to 1830 practically all of the crops now grown in the county had been introduced.

No attention was paid to the maintenance of fertility by the early settlers, new land being cleared upon the failure of the old fields. It is only within the last 20 or 30 years that any attention has been paid to the building up of the soil. At present a fairly definite system of cropping is used, although the systematic rotation of crops is not practiced. Liming has been practiced for about 15 years. Comparatively small amounts of commercial fertilizers are used. These include phosphates, bone meal, and some complete mixtures.

Although large numbers of cattle and sheep are kept in the county, only a relatively small acreage is in permanent pastures. As a rule the land used for this purpose consists of grass

lands that no longer produce profitable crops of hay. More and better cattle are kept now than ever before. The improvement of breeds has received attention for about 30 years. Herefords predominate. There are about the same number of sheep to-day as when the wool industry was at its highest, but the breeds kept now are for mutton.

There are no bearing commercial orchards in the county, although fruits, especially apples, do well. Small orchards in good condition are found on nearly every farm. Practically no attention is given to trucking, although several of the soil types are well suited to the growing of vegetables.

Of the entire land area of the county 71 per cent is in farms. Of this, 55.8 per cent is improved. The average size of the farms is 104.1 acres, and 90.3 per cent of the farms are operated by the owners.

Including Rough stony land eleven soil types, representing four soil series, were mapped. The Dekalb and Upshur series and Rough stony land occupied the upland, and the Huntington and Holly series the bottom-land areas of the county. The upland soils are derived from the weathering in place of the shales and sandstones of formations of the Carboniferous and Devonian periods. The bottom-land types are derived by wash from the upland types. The alluvial soils occupy a relatively smaller area than in other counties in West Virginia.

The Dekalb silty clay loam is the most extensively developed type in the area. It is well suited to general farming, and is particularly adapted to potatoes, buckwheat, and timothy. Apples and cherries do well.

The Dekalb silt loam is not so extensive but covers large areas in the southeastern part of the county. It is best adapted to potatoes, buckwheat, and apples.

The Dekalb stony loam and stony silt loam are best suited to grazing and orcharding.

Rough stony land is of little or no agricultural value. Its best use is for forestry.

The Upshur silty clay loam is the strongest soil in the area and is well adapted to general farming and stock raising. Wheat, oats, corn, clover, timothy, and bluegrass do well.

The Upshur silty clay loam is an excellent type for inter-

tilled crops, owing to the ease with which it can be cultivated. Oats, wheat, corn, and potatoes are the principal crops grown. It is best suited to oats. Vegetables do well.

The Upshur clay occurs in small areas but is typical of the soil as mapped in other areas in West Virginia. It is best suited to bluegrass and a considerable area is in pasture. Wheat, timothy, and clover do fairly well.

The Huntington silt loam is not very extensively developed. A large acreage is devoted to corn and timothy. The type is well adapted to these crops and to vegetables.

The Huntington sandy loam has the smallest total area of any soil type in the area. It is best suited to corn, peanuts, sorghum, sweet potatoes, melons, and leguminous crops such as cowpeas, soy beans, and vetch, and to early light truck crops.

The Holly silty clay loam occurs on the "glades." It is best suited to vegetables such as cabbage, onions, lettuce, celery, and squash. It is fairly well adapted to grass and buckwheat. Cranberries once grew wild upon this type, and conditions are favorable for the production of tame varieties.

CHAPTER XVI.

LEVELS ABOVE MEAN TIDE.

Main Line of the Baltimore and Ohio Railroad.

Distance from Grafton	Station	State.	County.	Elevation Above Tide. Feet.
0.0	Grafton (Old Station)...	W. Va.	Taylor	999.85
5.8	Thornton Fire Brick Co..	W. Va.	Taylor	.....
8.5	Ironton	W. Va.	Preston	1078.77
10.2	Hardman	W. Va.	Preston	1116.02
11.7	Independence	W. Va.	Preston	1165.86
15.0	Hiorra	W. Va.	Preston	1216.55
16.5	Austen	W. Va.	Preston	1575.35
18.1	West End.....	W. Va.	Preston	1736.99
21.3	Anderson	W. Va.	Preston	1857.40
25.8	Rowlesburg	W. Va.	Preston	1401.79
29.6	Amblersburg	W. Va.	Preston	1623.71
33.7	Tanners Siding.....	W. Va.	Preston	2001.35
38.2	Terra Alta.....	W. Va.	Preston	2549.25
42.0	Corinth	W. Va.	Preston	2432.25
42.7	Hutton	Md.	Garrett	2462.22
48.2	Oakland	Md.	Garrett	2378.51

WEST VIRGINIA GEOLOGICAL SURVEY.
Morgantown & Kingwood Railroad.

471

Distance from Morgantown	Station	State	County	Elevation (sub-grade)
0.0	Morgantown	W. Va.	Monongalia	824.0
9.0	Sturgissson	W. Va.	Monongalia	1410.0
9.1	Siding (Lumber Dock)...	W. Va.	Monongalia	1411.4
9.9	Iron Bridge.....	W. Va.	Monongalia	1450.0
10.0	Siding (Lick Run).....	W. Va.	Monongalia	1464.5
10.5	Lick Run.....	W. Va.	Monongalia	1481.5
12.5	Cascade (and Siding)....	W. Va.	Monongalia	1682.0
13.5	Masontown and Siding...	W. Va.	Preston	1683.0
14.0	Switch to Mine No. 6....	W. Va.	Preston	1691.8
14.7	Switch to Bretz Ovens...	W. Va.	Preston	1691.8
15.3	Bretz	W. Va.	Preston	1691.8
15.5	"Y" Bretz.....	W. Va.	Preston	1691.8
16.4	Switch (Mine No. 3)....	W. Va.	Preston	1695.9
17.1	Guseman's Siding.....	W. Va.	Preston	1698.2
17.7	Siding (Reedsville).....	W. Va.	Preston	1718.2
19.1	Gibson's Siding.....	W. Va.	Preston	1772.4
19.5	Siding in Big Cut.....	W. Va.	Preston	1814.9
21.5	Siding (Gibson Lum. Co.)	W. Va.	Preston	1990.4
21.6	Kanes Creek.....	W. Va.	Preston	1991.0
22.0	Sidwell Siding.....	W. Va.	Preston	2127.3
23.1	Summit and Siding.....	W. Va.	Preston	2154.7
23.1	Manown	W. Va.	Preston	2153.6
23.7	Cranes Siding.....	W. Va.	Preston	2096.2
25.5	Sutherland	W. Va.	Preston	1934.0
26.6	Pleasant Dale.....	W. Va.	Preston	1745.3
27.8	White's Siding.....	W. Va.	Preston	1737.5
28.1	Shaw's Siding	W. Va.	Preston	1664.3
28.5	Zevely-Casto Siding.....	W. Va.	Preston	1619.8
29.4	"Y" West Leg, Kingwood..	W. Va.	Preston	1671.2
....	"Y" East Leg, Kingwood..	W. Va.	Preston	1667.0
29.6	Kingwood	W. Va.	Preston	1666.0
29.7	Passing Siding, Kingwood	W. Va.	Preston	1666.0
31.4	Green's Run.....	W. Va.	Preston	1525.5
33.9	Albright	W. Va.	Preston	1286.6
34.1	Agent's Siding, Albright..	W. Va.	Preston	1273.2
34.2	Passing Siding, Albright..	W. Va.	Preston	1268.2
35.9	Passing Siding (Caddell)..	W. Va.	Preston	1245.2
36.2	Siding (King'd Lum. Co.)..	W. Va.	Preston	1247.2
36.3	Caddell	W. Va.	Preston	1247.5
38.3	Morgan's Run.....	W. Va.	Preston	1255.9
39.7	Trowbridge	W. Va.	Preston	1277.0
39.8	Siding, Trowbridge.....	W. Va.	Preston	1277.0
45.7	Passing Siding (Manheim)	W. Va.	Preston	1376.7
45.7	Manheim	W. Va.	Preston	1380.2
45.8	Siding (Cement Co.).....	W. Va.	Preston	1380.7
47.4	Rowlesburg	W. Va.	Preston	1390.0
47.5	"Y" Rowlesburg.....	W. Va.	Preston	1390.0
47.8	Siding, Rowlesburg.....	W. Va.	Preston	1396.5
47.9	M. & K. Junction.....	W. Va.	Preston	1401.5

For elevations determined by the U. S. Geological Survey, and arranged by quadrangles, the reader is referred to Bulletin II of the West Virginia Geological Survey, pages 122-130, inclusive.

PART IV.

Paleontology.

CHAPTER XVII.

NOTES ON THE PALEONTOLOGY OF PRESTON COUNTY.

By W. ARMSTRONG PRICE.

INTRODUCTION.*

The following report on the marine invertebrate fossils of the Conemaugh Series of Preston county is the result of collections made by the author in the field during the summer and fall of 1913, and in the laboratory during the spring and summer of 1914. Collections were made from localities noted by Messrs. Hennen and Reger during their field work on the area prior to that time. Collections were made from a large number of localities and in all the districts of the county in which the fossiliferous beds outcrop. Owing, however, to lack of time, it was necessary

*Thanks are due to Dr. G. H. Girty, whose large collections of Pennsylvanian fossils have been at the author's disposal for comparison of new and doubtful forms, and who has given his advice on doubtful points of identification. To Dr. R. S. Bassler for his kindness in searching the U. S. National Museum for Meek's type fossils from the Conemaugh of Monongalia county, the thanks of the author are likewise due, and also to Dr. W. B. Clark, of the Maryland Geological Survey, who has kindly loaned for comparison a collection of fossils from the Conemaugh of Maryland made by the writer previous to 1913, we are especially indebted.

to select for study only those collections which were considered to be the fullest, and in which the fossils were found to be in the best state of preservation. Consequently the study has not been as complete as might be desired, but it is thought that the list of fossils described contains all the common species with their relative abundance, and probably nearly all of the rarer species, which occur in the formations within the limits of the county. Certain non-marine species from limestones which are supposedly of fresh or brackish water origin have not been studied. These are mainly Ostracoda and allied crustaceans.

FAUNAL HORIZONS.

Marine invertebrate fossils have been found in three horizons in Preston county and in another limestone, the Albright, has been found a species of *Spirorbis*, which indicates probably brackish water conditions. These horizons are, beginning with the oldest, the Brush Creek, Pine Creek, Albright, and Ames limestones. The following table illustrates the positions of these limestones with regard to the other members of the series:

	Thickness. Feet.
Pittsburgh Coal (Monongahela Series).....	..
Conemaugh Series:	
Interval	5
Lower Pittsburgh Sandstone.....	35
Interval	9
Little Pittsburgh Coal.....	1
Interval	59
Connellsville Sandstone.....	40
Little Clarksburg Coal.....	1
Interval	68
Morgantown Sandstone.....	40
Elk Lick Coal.....	2
Interval	9
West Milford Coal.....	1
Birmingham Red Shale.....	10
Grafton Sandstone.....	40
<i>Ames Limestone</i> and shales, fossiliferous.....	20
Harlem Coal.....	2
Interval	15
Pittsburgh Red Shale.....	40
Saltsburg Sandstone.....	40
Bakerstown Coal.....	4
<i>Albright Limestone</i> , fossiliferous.....	2
Interval (red shale, fossils in lower part).....	10
<i>Pine Creek Limestone</i> , fossiliferous.....	1
Interval	15

	Thickness Feet.
Buffalo Sandstone.....	40
<i>Brush Creek Limestone</i> and shales, fossiliferous.....	30
Brush Creek Coal.....	1
Interval	5
Upper Mahoning Sandstone.....	20
Interval	10
Lower Mahoning Sandstone.....	45
Interval	10
Upper Freeport Coal (Allegheny Series).....	..

For a full description of the members of the Conemaugh Series, the reader is referred to the general section above, pages 113-114, only the more important beds being given in this table.

The following description of the fossiliferous beds will be confined in the main to their faunal content. The lithologic features have been described above by Hennen and Reger in chapter VI, pages 112-150, dealing with the stratigraphy of the series.

Ames Limestone.

This is not only the most persistent and fossiliferous of the faunal horizons in the series, but is also the one from which collecting is most easily done, since the fossils readily weather out from the matrix, and there is not the pronounced tendency for the fossiliferous beds to act as water carriers, with the attendant leaching of the shells, as in the Brush Creek. No attempt has here been made to separate the faunas of the different zones comprised within the 20 or 30 feet of fossiliferous limestone and shales, which are grouped together as a unit for convenience, although it is recognized that there is a marked difference in the faunules contiguous to each other, the variation apparently being coincident with changes in the relative amount of calcium carbonate and shaly matter in the matrix, the brachiopoda and certain pelecypoda increasing in numbers in the more calcareous layers. In view of this difference in the faunules the strict propriety of grouping fossiliferous shale and fossiliferous limestone under the same stratigraphic name is questionable. However, until more work is done on this phase of Conemaugh paleontology, it is not thought expedient to introduce a new terminology. This limestone is the "key rock" of the Pennsylvanian system in

this region and forms an excellent datum plane for stratigraphic investigations.

Although the Ames is unique in the series in many ways, yet a close scrutiny of its fauna is necessary before it may, in all cases, be distinguished from the other fossiliferous horizons of the Conemaugh, and especially from the Brush Creek. The most distinct feature of this bed, at many of the localities examined, and one which stands out best in outcrops which have for some time undergone subaerial weathering without erosion, is a highly calcareous layer, usually termed a "Limestone," found at or near the bottom of the formation. It is composed of a mass of *Chonetes granulifer*, *Ambocoelia planiconvexa*, *Derbya crassa*, *Nucula parva*, and other less abundant species. These species, with *Patellostium montfortianum* and *Euphemus carbonarius*, are the most abundant and noticeable fossils of the Ames. Of these, only *Ambocoelia planiconvexa* is restricted to it. *Chonetes granulifer*, however, can be used as a guide fossil of this horizon, as it here reaches a larger size than in the Brush Creek and is not found in the Pine Creek. Specimens from the Brush Creek having a length of hinge line greater than 9 mm. have not been found, while in the Ames the common size is 12 mm. or larger. Of the rarer species restricted to this horizon are *Solenomya radiata*, *Prothyris elegans*, *Sphaerodoma ? brevis*, *Sphaerodoma ? primigenia*, and its variety *intermedia*, *Sphaerodoma ? ventricosa*, and *Worthenia (Orestes) intertexta*. Others may be found in the Table of Stratigraphic Distribution of the fossils, following the description of the Brush Creek limestone, but they are known in the county mainly at a single locality or from a single specimen.

A collection from the Ames limestone, 1 mile north of Kingwood, was made in 1911 by Dr. J. W. Beede, who listed the following forms in the report on Monongalia, Marion and Taylor counties, 1913, page 293:

Aclisina ? sp.
Aclisina swallowana.
Ambocoelia planiconvexa, a.
Astartella gurleyi, c.
Astartella vera, r.
Aviculopecten sp., r.
Bulimorpha chrysalis.
Bellerophon percarinatus.
Bellerophon stevensanus ? r.

Bulimorpha sp.
Bulimorpha ? sp.
Chonetes granulifer, c.
Chonetes variolatus.
 Crinoid fragments.
Derbya crassa, c.
Edmondia aspenwallensis?
Endothyra ? sp., r.
Euomphalus catilloides.
Euphemis carbonarius, c.
Leda attenuata, c.
Loxonema rugosum, r.
Loxonema semicostatum, r.
Loxonema scitulum, r.
Nucula parva, a.
Orthoceras rushensis.
Orthonema quadricarinatum.
Orthonema ? sp.
Orthonema Cf. *subtaeniatum*, r.
Patellostium montfortianum.
Pelecypod. Cf. *Allorisma geinitzi*.
Pelecypod. Two species.
Pleurophorus Cf. *obsoletus*.
Pleutomaria Cf. *brazoensis*.
Productus cora? r.
Serpula ? sp., r.
Sphaerodoma primigenia?
Soleniscus brevis.
Soleniscus paludinaeformis?
Tainoceras occidentalis? r.
Worthenia Cf. *speciosa*, a.

Albright Limestone.

This bed is known at but a single locality and there consists of 2 feet of limestone underlying the Bakerstown coal. Beneath the limestone is a bed of clay, 10 feet in thickness, the upper 2 feet of which is full of *Spirorbis* (*Microconchus*) *pusillus*. No other fossil is found in this bed. This *Spirorbis* is elsewhere usually found attached to, or partly buried in the exterior surface of some foreign object, usually the shell of an animal, or a plant stem or leaf. In this bed there are no traces of attachment of the tiny shells, but as the specimens are mostly casts, it cannot be definitely stated that they may not have been attached at one time. The presumption is that they were not, as there is no trace of objects to which they might have been fastened. As may be inferred from their occurrence (as has been demonstrated in the past in other areas) with both plants and marine shells, these small worms were capable of existing in either salt, or brackish, or possibly in fresh water. Just what were the conditions here

during the deposition of the Albright limestone is not clear, but at least it is probable that there was water connection with the sea at a more or less distant point, and it is certain that conditions were not favorable for the return of the strictly marine fauna of the Pine Creek limestone, with which this *Spirorbis* was associated.

Pine Creek Limestone.

This horizon is quite variable in its character. It was found to have three distinct phases within the limits of the county, a highly fossiliferous phase, a scantily fossiliferous and probably non-marine phase, and a barren phase. The highly fossiliferous phase is characterized by an abundant brachiopod fauna of thirteen species, most of which are abundant or quite common, four species of pelecypoda and these few in numbers, one cephalopod, one scaphopod, and one chaetopod, none of which appears to be abundant except the brachiopoda. *Orbiculoidea convexa*, *Productus semireticulatus*, and *P. insinuatus* seem to be restricted to this phase of the horizon; from the Ames limestone, it will be readily distinguished by the abundance of *Spirifer cameratus*, *Chonetes verneuillanus*, and the presence of other species which are not found in the Ames, and by the absence of the profuse gastropod and pelecypod fauna of that bed. From the Brush Creek it will be distinguished by its typically brachiopod fauna and the absence of species to be noted below as characteristic of that horizon.

The scantily fossiliferous phase is characterized by the abundance of a single fossil, *Spirorbis* (*Microconchus*) *pusillus*, noted above as occurring alone in the Albright limestone. The matrix of this fossil is apparently much the same in the two cases. This condition was found at one locality only. The horizon is barren of fossils over the larger portion of the county.

Brush Creek Limestone.

This limestone with its associated fossiliferous shale bears fossils over most of the area, but south of the line of 39 degrees 25 minutes north latitude, in the southern part of Lyon district,

and in Reno district, it is apparently entirely barren of fossils, although the underlying coal is present, and the plant bearing, black shale, which usually separates the coal from the faunal shales, is characteristically developed.

This fauna is characterized by the abundance of *Chonetes verneuillanus*, *Bulimorpha nitidula*, *Lophophyllum profundum* and *Griffithides sangamonensis*, all of which are, with the exception of the first, found only at this horizon. *Chonetes granulifer*, not exceeding 9 mm. in length of hinge, is also a trustworthy guide fossil of the Brush Creek. Other less common species which have been found in no other horizon in the county will be found in the Table of Stratigraphic Distribution of the fossils, below. From the Pine Creek limestone fauna, this is distinguished by the abundance of pelecypoda and gastropoda which are few in numbers or lacking in that horizon. The entire absence of *Ambocoela planiconvexa* is another characteristic of this bed. It will be seen from a study of the distribution tables that the fauna of this horizon and that of the Pine Creek are more nearly related than those of the Pine Creek and Ames. Certain of the brachiopoda, which form the best horizon markers of the Pennsylvanian rocks, are found in these two but are lacking in the Ames. *Lingula umbonata*, *Orbiculoides missouriensis*, *Chonetes verneuillanus*, *Productus symmetricus*, and *Spirifer cameratus* fall in this category. This relationship is supported also by the other classes of fossils, although their evidence is not of as much value as that of the brachiopoda. The Ames and the Brush Creek resemble each other in the occurrence of a large number of the mollusca, which are almost absent from the Pine Creek. In spite of the differences above enumerated, these three limestones are closely related in their faunal content. It is expected that a study of further material already collected, but not included in this report, will show a closer relationship between the molluscan fauna of the Ames and Brush Creek, as was apparent from observations in the field while collecting. The brachiopoda, however, it is believed, are represented in their true relationship by the lists of fossils described in this report.

Tables of Faunal Distribution for the Conemaugh Series in Preston County.

The following tables show stratigraphic and geographic distribution in the county of the fossils included in this report. In the Table of Stratigraphic Distribution, forms are noted as abundant or common if they were found at more than one locality and are abundant or common, respectively, at one or more of these localities. A species occurring at only one locality is in all cases noted as rare, except in the case of the Albright limestone, which was found exposed at only one locality. The greater abundance of all species in the Ames as compared to the Brush Creek is due in part to the better preservation of the fossils in the Ames and the consequent greater ease of collecting from it. Several indeterminate forms have been omitted from the first table but appear in the second.

Following the tables is a Register of Localities, giving a brief description of each locality from which collections have been made:

Table of Stratigraphic Distribution of Marine Fossils of the Conemaugh Series of Preston County.

Abbreviations: "x" rare, at one or more localities; "c" common; "a" abundant; "aa" very abundant.

	Ames.	Pine Creek.	Brush Creek.
<i>Lophophyllum profundum</i>	..	..	a
<i>Vermes</i> indet.....	..	..	a
<i>Spirorbis</i> (<i>Microconchus</i>) <i>pusillus</i> *.....	..	aa	..
<i>Crinoidea</i>	c	a	aa
<i>Bryozoa</i>	..	..	c
<i>Rhombopora lepidodendroides</i> ?.....	..	c	c
<i>Lingula umbonata</i>	..	x	x
<i>Orbiculoidea missouriensis</i>	..	x	x
<i>Orbiculoidea convexa</i>	..	x	..
<i>Derbya crassa</i>	a	x	c
<i>Chonetes granulifer</i>	aa	..	c
<i>Chonetes verneuillanus</i>	..	a	c
<i>Productus semireticulatus</i>	..	x	..
<i>Productus cora</i>	c	a	a
<i>Productus insinuatus</i>	..	x	..
<i>Productus pertenuis</i>	c	c	c

*Albright limestone, at one locality, aa.

Table of Stratigraphic Distribution of Marine Fossils of the Conemaugh Series of Preston County.—Continued.

Abbreviations: "x" rare, at one or more localities; "c" common; "a" abundant; "aa" very abundant.

	Ames	Pine Creek	Brush Creek.
<i>Productus nebraskensis</i>	a	a	a
<i>Productus symmetricus</i>	..	c	a
<i>Spirifer cameratus</i>	..	a	x
<i>Ambocoelia planiconvexa</i>	aa	..	..
<i>Composita subtilita</i>	x	a	a
<i>Solenomya radiata</i>	x	..	..
<i>Solenomya soleniformis</i>	x	..	..
<i>Prothyris elegans</i>	c	..	..
<i>Solenopsis solenoides</i>	x	..	x
<i>Chaenomya leavenworthensis</i>	..	..	x
<i>Edmondia</i> ? <i>scutum</i> , sp. n.....	x	..	..
<i>Edmondia aspinwallensis</i>	..	..	x
<i>Edmondia ovata</i>	..	..	x
<i>Edmondia ovata</i> var. <i>levis</i> , var. nov.....	x	..	..
<i>Edmondia gibbosa</i>	x	..	..
<i>Nucula anodontoides</i>	a	..	c
<i>Nucula parva</i>	aa	..	c
<i>Anthraconeilo taffiana</i>	a	..	x
<i>Leda bellistriata</i> ?.....	c	x	x
<i>Leda meekana</i>	a	..	c
<i>Parallelodon sangamonensis</i>	..	..	x
<i>Parallelodon obsoletus</i>	..	..	x
<i>Aviculipinna americana</i>	x	..	x
<i>Myalina perniiformis</i>	x	..	..
<i>Myalina</i> sp.....	..	..	x
<i>Schizodus affinis</i> ?.....	x	..	x
<i>Aviculipecten rectilaterarius</i>	c	..	..
<i>Aviculipecten hertzeri</i>	..	..	x
<i>Aviculipecten pellucidus</i>	..	..	c
<i>Acanthopecten carboniferous</i>	x	x	c
<i>Dellopecten occidentalis</i>	a	x	a
<i>Euchondria neglecta</i>	..	x	c
<i>Lima retifera</i>	x	..	..
<i>Allerisma terminale</i>	..	..	x
<i>Pleurophorus occidentalis</i>	a	..	x
<i>Pleurophorella geinitzi</i>	c	..	..
<i>Astartella concentrica</i>	x	..	a
<i>Plagioglypta meekana</i>	..	x	x
<i>Bellerophon crassus</i> var. <i>wewokanus</i>	x	..	..
<i>Patellostium montfortianum</i>	aa	..	x
<i>Euphemus carbonarius</i>	aa	..	c
<i>Bucanopsis perlata</i>	a	..	..
<i>Bucanopsis kansasensis</i>	x	..	..
<i>Bucanopsis</i> ? sp.....	x	..	x
<i>Pharkidonotus percarinatus</i>	x	..	c
<i>Pharkidonotus percarinatus</i> var. <i>tricarinatus</i> ...	a	..	..
<i>Worthenia</i> (<i>Orestes</i>) <i>intertexta</i>	a	..	..
<i>Phanerotrema grayvillense</i>	a	..	c

Table of Stratigraphic Distribution of Marine Fossils of the Conemaugh Series of Preston County.—Continued.

Abbreviations: "x" rare, at one or more localities; "c" common; "a" abundant; "aa" very abundant.

	Ames.	Pine Creek.	Brush Creek.
Schizostoma catilloides.....	a	..	c
Zygopleura plicata.....	c	..	x
Zygopleura sp.....	x	..	..
Sphaerodoma ? brevis.....	x	..	..
Sphaerodoma ? primigenia.....	x	..	..
Sphaerodoma ? primigenia var. intermedia, var. nov.....	x	..	..
Sphaerodoma ? ventricosa.....	x	..	..
Sphaerodoma ? fusiformis.....	..	..	?
Bulimorpha nitidula.....	..	..	a
Orthoceras colletti.....	..	x	a
Pseudorthoceras knoxense.....	x	..	a
Tainoceras occidentale.....	x	..	x
Griffithides sangamonensis.....	..	..	a

Table of Geographical Distribution of Marine Fossils of the Conemaugh Series of Preston County.

(Numbers refer to localities from which collections have been studied. See Register of Localities).

	1	2	3	4	7	8	9	9a	15	16	19	23	25	27	30	32	33
Lophophyllum profundum.....	..	..	a	..	..	..	..	..	..	x	..	..	..	..	..	..	..
Vermes indet.....	..	..	..	..	a	..	..	..	..	x	..	..	..	..	..	..	..
Spirorbis (Microconchus) pusillus.....	aa	..	..	..	..	x	..	a	..	..	..	..	..	..	..	aa	..
Crinoidea.....	..	..	a	..	x	c	a	..	aa	x	..	x	c	c	..	..	x
Bryozoa.....	..	..	x	..	..	..	..	..	x	..	..	..	..	..	..	..	x
Rhombopora lepidodendroides ?.....	..	..	..	x	x	..	c	..	..	..	..	..	..	..	..	..	c
Lingula umbonata.....	..	..	..	..	..	x	..	x	..	..	..	..	..	..	..	..	..
Orbiculoidea missouriensis.....	..	..	..	..	..	x	x	..	..	..	..	..	..	..	..	..	x
Orbiculoidea convexa.....	..	..	..	..	..	x	..	..	..	..	..	..	..	..	..	..	..
Derbya crassa.....	..	x	c	..	..	a	..	..	c	x	c	c	x	x	x	..	..
Chonetes granulifer.....	..	..	c	..	..	..	..	..	..	..	..	aa	a	aa	c	..	c
Chonetes verneuianus.....	..	x	x	c	x	a	..	..	x	x	..	..	..	..	..	..	c
Productus semireticulatus.....	..	..	..	..	..	x	x	..	..	..	..	..	..	..	..	..	..
Productus cora.....	..	..	..	..	..	a	x	..	a	..	..	x	..	x	c	..	..
Productus insinuatus.....	..	..	..	..	..	x	..	..	..	..	..	..	..	..	..	..	..
Productus pertenuis.....	..	c	x	..	..	x	c	..	c	..	..	c	c	c	c	..	..
Productus nebraskensis.....	..	..	c	..	c	a	a	..	a	..	..	x	..	..	a	..	..
Productus symmetricus.....	..	..	x	..	c	..	..	..	c	x	..	..	..	..	..	a	..
Spirifer cameratus.....	..	..	..	..	..	c	..	..	x	x	..	..	..	..	..	..	..
Ambocoelia planiconvexa.....	..	..	a	..	..	..	..	..	..	..	aa	aa	a	a	a	..	..
Composita subtilita.....	..	..	c	..	..	a	a	..	x	..	..	..	..	..	..	..	a
Solenomya radiata.....	..	..	..	..	..	..	..	..	..	..	x	..	x	..	..	..	..
Solenomya soleniformis.....	..	..	..	..	..	..	..	..	..	..	..	..	x	..	..	..	..
Prothyris elegans.....	..	..	x	..	..	..	..	..	..	..	c	x	x	c	..	..	..
Solenopsis solenoides.....	..	..	..	x	..	..	..	..	..	..	..	..	..	x	..	..	..
Chaenomya leavenworthensis.....	..	..	..	..	..	..	..	..	..	x	..	..	..	..	..	..	..
Edmondia ? scutum.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	x	..
Edmondia ? sp. 1.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	x	..
Edmondia ? sp. 2.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	x	..
Edmondia ? sp. indet. 1.....	..	..	..	..	x	..	..	..	..	..	..	..	..	..	..	x	..
Edmondia ? sp. indet. 2.....	..	..	..	..	..	x	..	..	..	..	..	..	..	..	..	x	..
Edmondia aspinwallensis.....	..	..	..	..	..	..	..	..	..	x	..	..	..	..	..	..	..

Table of Geographical Distribution of Marine Fossils of the Conemaugh Series of Preston County.—Continued.

(Numbers refer to localities from which collections have been studied. See Register of Localities).

	1	2	3	4	7	8	9	9a	15	16	19	23	25	27	30	32	33
<i>Edmondia ovata</i>			x														
<i>Edmondia ovata</i> var. <i>levis</i>												x					
<i>Edmondia gibbosa</i>												c		?			
<i>Nucula anodontoides</i>			x		c					?		a	a	a	x		
<i>Nucella parva</i>			a	c						x		aa	aa	aa			
<i>Anthraconeilo taffiana</i>				x								a		a			
<i>Leda bellistriata</i> ?.....						x						c	x	c			x
<i>Leda meekana</i>			x		c					c		x	a	a			x
<i>Parallelodon sangamonensis</i>			x	c						c		x					x
<i>Parallelodon obsoletus</i>			c														
<i>Aviculinpinna americana</i>			c												a		x
<i>Myalina perniformis</i>																x	
<i>Myalina</i> sp.....								x									
<i>Schizodus affinis</i> ?.....												x		x			x
<i>Schizodus</i> sp. indet.....												x					
<i>Aviculipecten rectilaterarius</i>												x	x	c			
<i>Aviculipecten hertzeri</i>			x									x					x
<i>Aviculipecten pellucidus</i>			c	x						x							
<i>Acanthopecten carboniferous</i>			x			x			x						c		c
<i>Deltopecten occidentalis</i>				x	x				x	c		a		x	a		a
<i>Euchondria neglecta</i>			x			x				c							
<i>Lima rectifera</i>													x	x			
<i>Allerisma terminale</i>									c								
<i>Pleurophorus occidentalis</i>					x							a	a	x			
<i>Pleurophorella geinitzi</i>												c	c				
<i>Astartella concentrica</i>			a	x						a		x					a
<i>Pelecypod</i> indet. 1.....																	
<i>Pelecypod</i> indet. 2.....																	
<i>Plagioglypta meekana</i>			x			x				x							x
<i>Bellerophon crassus</i> var. <i>wewokanus</i>													x		x		
<i>Patellostium montfortianum</i>									c			aa	a	aa			
<i>Euphemus carbonarius</i>		x			c					x		aa	a	aa			
<i>Bucanopsis perlata</i>												c		a			
<i>Bucanopsis kansascensis</i>												x		x			
<i>Bucanopsis</i> ? sp.....		x												x			x
<i>Pharkidonotus percarinatus</i>			c											x			x
<i>Pharkidonotus percarinatus</i> var.																	
<i>tricarinatus</i>			x										a	c	a		
<i>Worthenia (Oicstes) intertexta</i>												a	x	c			
<i>Phancrotrema grayvillense</i>		x	c							x		a	c	c			
<i>Schizostoma catilloides</i>			c	x	x					c		a	c	a	x		
<i>Zygopleura plicata</i>			?									c		x			x
<i>Zygopleura</i> sp.....											x						
<i>Sphaerodoma</i> ? <i>brevis</i>												x	?	x			
<i>Sphaerodoma</i> ? <i>primigenia</i>												c					
<i>Sphaerodoma</i> ? <i>primigenia</i> var.																	
<i>intermedia</i>																	
<i>Sphaerodoma</i> ? <i>ventricosa</i>											x	x		x			
<i>Sphaerodoma</i> ? <i>fusiformis</i> ?.....																	?
<i>Sphaerodoma</i> ? sp. indet.....				x										x			x
<i>Bulimorpha nitidula</i>			x	x	c					a							
<i>Aclisina stevensiana</i>																	
<i>Orthoceras colletti</i>			a			x											c
<i>Orthoceras</i> sp. indet.....												x		x			
<i>Pseudorthoceras knoxense</i>			x							x		x		x			a
<i>Tainoceras occidentale</i>			?								x	?	?	x			c
<i>Nautilioidea</i> indet.....										x				x			c
<i>Griffithides sangamonensis</i>			a						a	c							
<i>Trilobita incerta</i>			x														

The Corinth Basin.

When the description of the fossils of this report was written, only a small collection of the fossils of this basin had been made and the single fossiliferous bed which has been found out-

cropping in the Conemaugh Series there was thought to be undoubtedly the Brush Creek limestone, as it had been determined in the field by Messrs. Hennen and Reger, and as it is described in the chapters on the geology of Preston county in this report. A further collection has resulted in the finding of the fossils in the following list, collected from two localities in Garrett county, Maryland, not far from the West Virginia State Line. No outcrops of the horizon have been discovered in West Virginia:

List of Fossils from the Corinth Basin, Maryland, from Two Localities in the Same Geological Horizon.

	69	70
<i>Derbya crassa</i>	..	a
<i>Chonetes granulifer</i>	x	a
<i>Productus pertenuis</i>	..	x
<i>Ambocoelia planiconvexa</i>	..	x
<i>Prothyris elegans</i>	x	..
<i>Nucula anodontoides</i>	x	..
<i>Nucula parva</i>	x	x
<i>Anthraconeilo taffiana</i>	x	..
<i>Leda bellistriata</i> ?.....	..	x
<i>Leda meekana</i>	..	x
<i>Parallelodon obsoletus</i>	..	?
<i>Schizodus cf. affinis</i>	..	x
<i>Aviculipecten rectilaterarius</i>	x	..
<i>Pectinoid</i> indet.....	..	x
<i>Pleurophorus occidentalis</i>	..	x
<i>Pleurophorella geinitzi</i>	..	x
<i>Astartella concentrica</i>	..	c
<i>Pelecypod</i> indet. 1.....	x	..
<i>Pelecypod</i> indet. 2.....	x	..
<i>Bellerophon crassus</i> var. <i>wewokanus</i>	..	c
<i>Patellostium montfortianum</i>	c	c
<i>Euphemus carbonarius</i>	c	c
<i>Bucanopsis perlata</i>	x	x
<i>Bucanopsis kansasensis</i>	x	..
<i>Pharkidonotus percarinatus</i> var. <i>tricarinatus</i>	x	c
<i>Phanerotrema grayvillense</i>	..	x
<i>Schizostoma catilloides</i>	..	c
<i>Sphaerodoma ? ventricosa</i>	..	x
<i>Sphaerodoma ? sp. indet.</i>	..	x
<i>Aclisina stevensiana</i>	..	a
<i>Orthoceras sp. indet.</i>	x	..
<i>Tainoceras occidentale</i>	?	..

It will be seen from the above list that the diagnostic features of the Ames and of the Brush Creek are lacking. *Ambocoelia planiconvexa* occurs, but not in its characteristic profusion

as always in the Ames limestone. The specimens of *Chonetes granulifer* attain a size greater than in the Brush Creek and are as large as those of the Ames. The guide fossils of the Brush Creek are *all lacking*. As the number of fossils restricted to the Brush Creek is comparatively large and as several of them are widespread and abundant, their absence in the bed under discussion is very significant. From the partial similarity of the fauna to the Ames, taken in connection with the absence of a profusion of *Ambocoelia planiconvexa*, and the dissimilarity of the outcrop of the bed in its lithologic features to the Ames limestone and its associated shales, it is concluded that it represents a horizon and fauna closely related to the Ames limestone, but not so far found in West Virginia. It is probably to be correlated with a fossiliferous horizon known to occur in Maryland, in the basins to the north and east of the Corinth Basin, immediately above, or separated from, by a thickness of as much as 20 feet of black shale, the Bakerstown coal of that region. This horizon is correlated in Maryland with the Woods Run limestone of Pennsylvania. The fauna of the Corinth Basin as here given bears a close resemblance to that collected by the author and reported on to the Maryland Geological Survey in a volume soon to be published by that Survey.

Whether the lithology and stratigraphy of the Corinth Basin will bear of this interpretation is not known at the present time, and hence the correlation here proposed can be only tentative to a further study of the basin. This correlation would probably not affect the naming of the large coal of the basin which is in the Allegheny series.

The section exposed in the cut of the B. & O. R. R. at Hut-ton, Maryland, Locality 70, of the above list of fossils, as measured by the writer, follows:

	Ft.	In.
Concealed	5	0
Clay, yellow and brown.....	1	6
Shale, brown and black, fossiliferous.....	1	2
Coal, soft.....	0	10
Clay, brown.....	3	0

Railroad grade, 2480' B.A. T., 100' east of W. Va.-Md. State Line Post.

The outcrop of this bed 4 miles northwest of Oakland, Locality 69, is in a spring and shows about 2 feet of yellow clay

under a bed of sandstone. The outcrop is poor and the thickness of the beds was not ascertained by the writer.

Register of Localities.

The following list includes all localities in the county from which fossil collections have been made by the writer, together with the name of the fossiliferous bed outcropping at each locality. An asterisk (*) denotes those localities the collections from which have been studied and are included in this report:

- 1.* Kingwood district, Albright, west side of Cheat river, side of road below M. & K. R. R. grade crossing, 2 feet of gray shale under the Albright limestone, 1265' L-A. T.
- 2.* Portland district, 1.3 miles northeast of mouth of Roaring Creek, old prospect hole at side of road from mouth of creek up the hill to Lenox, 1660' B-A. T., Ames limestone.
- 3.* Grant district, 0.9 mile west of Bruceton Mills, on hill north of road to Hopewell Church, 1826' L-A. T., Brush Creek limestone.
- 4.* Grant district, 1.1 miles west of Clifton Mills, Haydentown Road, 1838' L-A. T., Brush Creek limestone.
5. Grant district, 1.2 miles south of Clifton Mills, hillside above Big Sandy creek, west side, coal and limestone opening, Lower Freeport (non-marine) limestone.
6. Grant district, 0.9 mile northwest of Hopewell Church, hill east of Hazel Run, 1995' B-A. T., and 45' below top of hill, Ames limestone.
- 7.* Grant district, 2.1 miles north of Hopewell Church, 1800' B-A. T., roadside top of hill, 0.25 mile south of Brandonville to Florence road, cellar of old house east side of road, Brush Creek limestone.
- 8.* Grant district, 0.8 mile south of Brandonville, road to Morgans Glade, land of Philmer Corphenning, 1920' B-A. T., Pine Creek limestone.
- 9.* Grant district, 0.7 mile south of Laurel Church, old prospect hole, 35' below top of hill, east side, on land of Thad. Benson, Pine Creek limestone.
- 9a.* Pleasant district, 0.9 mile north of Valleypoint, quarry in limestone, 700' north of secondary road leading from the Albright-Bruceton pike to Gusemans Mills, Pine Creek limestone.
10. Grant district, about $\frac{3}{4}$ mile east of Beaverhole, north bank of Cheat river, side of road, limestone quarry about 0.2 mile east of Christopher run, Greenbrier formation.
11. Grant district, 1.3 miles south of Glade Farms, secondary road at source of easternmost branch of Hog Run of Little Sandy creek, Brush Creek limestone.
12. Grant district, 0.5 mile southwest of Five Forks, 0.3 mile south of Mason and Dixon Line, abandoned coal mine, Upper Freeport (non-marine) limestone.
13. Grant district, 1.5 miles southwest of Fearer, Md., and 0.3 mile south of Rock Run branch of Buffalo Run, limestone quarry of Joshua Fike, Lower Freeport (non-marine) limestone.

- 14.* Upper bed, red shale, over limestone at Locality 8, Pine Creek limestone.
- 15.* Grant district, 1.2 miles southeast of Brandonville, side of east and west road from Barnes Run, and 0.4 mile east of junction of this road with Brandonville—Morgans Glade road, 1822' B-A. T., Brush Creek limestone.
- 16.* Grant district, 0.9 mile northeast of Bruceton Mills, side of Haydentown road, 1800' L-A. T., Brush Creek limestone.
17. Kingwood district, cut on M. & K. R. R. just east of its depot at Kingwood, 1' above track level, Upper Ames limestone.
18. Kingwood district, east side of south fork of Green Run, third cut northeast of Kingwood on M. & K. R. R., 7' above the profuse faunal zone of the Ames, Upper Ames limestone.
- 19.* Kingwood district, M. & K. R. R., 0.9 mile northeast of its depot at Kingwood, at crossing of small left hand branch of south fork of Greens Run, Ames limestone. (Locality of collection by J. W. Beede, W. Va. Geol. Survey, 1913, Report, Monongalia, Marion and Taylor Counties, page 293, list. See above, page 475.)
20. Kingwood district, M. & K. R. R., 0.5 mile northwest of Cheat River, bridge at Albright, on east side of south fork of Greens run, and 1600' east of tunnel, 1415' B-A. T., Ames limestone.
21. Kingwood district, ravine in hillside north of Dunkard Bottom and 0.4 mile southwest of Caddell depot of the M. & K. R. R., 169' (hand level) above railroad grade, Ames limestone.
22. Kingwood district, roadside south of Morgan run, 1.2 miles northwest of Snyder, 2500' A. T., U. S. G. S. contours, Brush Creek limestone.
- 23.* Portland district, east side of Cheat river, 0.6 mile east of Trowbridge, near head of ravine, 1600' A. T., U. S. G. S. contours, Ames limestone.
24. Lyon district, 1.1 miles southeast of U. S. G. S. B. M. at Oriole, hillside west of right fork of Bird creek, roadside, 1710' B-A. T., Ames limestone.
- 25.* Lyon district, 1.1 miles north of Newburg at road fork on first right hand branch of Cooks run, 1395' L-A. T., Ames limestone.
26. Lyon district, 2.1 miles southeast of Gladesville, south of Beverly turnpike on Martins run and east of first left hand branch of same, great landslide scar, 1540' B-A. T., Brush Creek limestone.
- 27.* Reno district, coal mine of John Runner, 0.5 mile northwest of Fellowsville, west side of left hand branch of Little Sandy creek which turns off just west of mouth of Left Fork, 1515' B-A. T., Ames limestone.
28. Reno district, small ravine southeast side of hill between Maple run and first left hand branch of Little Sandy creek, 1.0 mile west of Evansville, 1510' B-A. T., Ames limestone.
29. Lyon district, ravine at roadside west of Maple run, 2.3 miles northwest of Evansville, 1435' B-A. T., Ames limestone.
- 30.* Reno district, 0.1 mile south of forks of left fork of Tibbs run, roadside, 2.6 miles east of Fellowsville, 2020' B-A. T., Ames limestone.
31. Reno district, first left hand branch of third left hand branch of Left Fork of Sandy creek, 1.5 miles southeast of Fellowsville, 1545' B-A. T., Ames limestone.
- 32.* Valley district, 1.2 miles east of Reedsville, Kingwood turnpike, 1920' A. T., U. S. G. S. contours, Pine Creek limestone.

- 33.* Valley district, 2.1 miles east of Reedsville, Kingwood turnpike, 2170' B-A. T., Brush Creek limestone.
- 34. Valley district, Tunnelton and Ices Ferry turnpike, hillside west of Stony run, 0.5 mile southwest of Browns Mills, 1590' B-A. T., Brush Creek limestone.
- 35. Valley district, side of road up Stacks run, 0.3 mile southeast of Browns Mills, 1715' B-A. T., Ames limestone.
- 36. Portland district, roadside north of Cheat river, 0.7 mile west of wagon bridge over same at Rowlesburg, 1455' B-A. T., Chemung formation.
- 69.* District No. 14, Oakland, Garrett county, Maryland, spring 0.3 mile from Herrington creek and 400 feet west of Swallow Falls road, on first left hand branch above Murley run mouth, and 4 miles northwest of Oakland, Md., 2460' B-A. T., Brush Creek limestone (?). (Bore hole recorded in Maryland Geological Survey, Report 1902, Garrett county, p. 117, about 20 or 30 feet below this spring.)
- 70.* District No. 4, Oakland, Garrett county, Maryland, B. & O. R. R. cut just west of depot at Hutton, Maryland, and just east of W. Va.-Md. State Line Post, 2480' B-A. T., Brush Creek limestone.

DESCRIPTION OF SPECIES.*

COELENTERATA

ANTHOZOA

Family Zaphrentidae

Genus LOPHOPHYLLUM Milne Edwards and Haime

Lophophyllum profundum (Milne Edwards and Haime)

Description.—Corallum conical, apparently straight, tapering to the pointed base, nearly circular or elliptical in cross-section. Distinct, encircling wrinkles of growth crossing the finer and more regular longitudinal striae and producing the appearance of revolving rows of nodes. Epitheca thin; septa of two sizes, the longer extending to the columella; the shorter septa alternating with the others in position; the longer or primary septa about 22 in number. Length of longest specimen, 21 mm., breadth, 10 mm.

Our specimens are all casts, the shell having been leached out, leaving an impression of the exterior of the corallum with a mold of the interior showing the number and position of the septæ. The exact number of the latter cannot be counted, as the mold is in no case perfect. The size and shape of the columella are not shown. However, there is little doubt as to the specific identification, as the fossil is a common one in the Conemaugh of the Appalachian region.

Occurrence.—Conemaugh Series, BRUSH CREEK LIMESTONE, Grant district, 0.9 mile west of Bruceton Mills, (a)*; and 0.9 mile northeast of Bruceton Mills.

Collection.—West Virginia Geological Survey.

VERMES

Vermes indet.

Numerous indefinite, slightly sinuous tubes are possibly to

*The following abbreviations are used in this report: "a," abundant; "aa," very abundant; "c," common. Where no symbol follows the description of the locality, the species is rare.

be interpreted as worm borings, though some of the narrower ones may be bryozoa of the type of *Rhombopora*. Breadth about 1 mm.; length of longest specimen of this type, 18 mm. One specimen with a length of 40 mm. and a breadth of 10 mm. is at hand, but may be a portion of a plant stem; no markings whatever are seen upon any of the specimens.

Occurrence.—Conemaugh Series, BRUSH CREEK LIMESTONE, at many localities.

Collection.—West Virginia Geological Survey.

CHAETOPODA.

Genus SPIRORBIS Daudin

Section MICROCONCHUS Murchison

Spirorbis (*Microconchus*) *pusillus* (Martin)

Conch. (*Helicites*) *pusillus*. Martin, 1809, *Pet. Derb.*, t. 52, f. 2, 3.

Microconchus carbonarius. Murchison, 1839, *Sil. Syst.*, p. 84, figs. DI-DIO, p. 88.

Description.—Our specimens show dextral coils of from two to two and one-half revolutions; umbilicus distinct; shell transversely and finely striated; none attached, but as all the specimens at hand which are entire are casts of the interior of the shell, it cannot be definitely stated that they have not been attached and broken off. Diameter of the coil, 2—2.5 mm.

This species has been widely studied and compared by Etheridge¹, who places the shell commonly described in America as *S. carbonarius* in the synonymy of *S. pusillus* (Martin). It would seem hardly probable that these little shells in this country and Europe should belong to the same species, but as there appear to be no adequate differences between them, and as Dawson², who compared specimens from the two continents, was of the opinion that they are the same, there seem to be no data at present for separating them.

1. *Geol. Mag. (London)*, 1880, Dec. ii, vol. vii., pp. 113-115, 171-174, 215-222, pl. vii, figs. 1-7.

2. Dawson, *Acadian Geol.*, 1868, 2d ed., p. 205.

Occurrence.—Conemaugh Series, ALBRIGHT LIMESTONE, Kingwood district, Albright west side Cheat river, (aa); PINE CREEK LIMESTONE, Grant district, 0.8 mile south of Brandonville; Pleasant district, 0.9 mile north of Valleypoint, (a); Valley district, 1.2 miles east of Reedsville, (aa).

Collections.—West Virginia Geological Survey and West Virginia University.

ECHINODERMATA.

CRINOIDEA

Crinoid stems are abundant in the shales and limestones of the AMES, PINE CREEK, and BRUSH CREEK LIMESTONES throughout the county, and occasionally odd plates and spines are found.

MOLLUSCOIDEA.

BRYOZOA.

The bryozoan material is poor and scanty, consisting of exterior molds in sandstone and shale which do not show the details of the surface. Several species are represented in the collection, among which are specimens of what appears to be *Rhombopora lepidodendroides* Meek.

Occurrence.—Conemaugh Series, PINE CREEK and BRUSH CREEK LIMESTONES.

BRACHIOPODA

Family Lingulidae

Genus LINGULA Bruguiere

Lingula umbonata Cox

Lingula umbonata. Cox, 1857, Kentucky Geol. Surv., vol. iii, p. 575, pl. x, figs. 4, 4a.

3. West Virginia Geol. Survey, 1914, Kanawha County Report, p. 646, pl. i. figs. 3, 4.

Coal Measures: Crittenden, Union, and Hancock counties, Kentucky.

Description.—Two specimens of this species were found in Preston county and resemble those described and figured from the Kanawha series³, one being slightly more slender, but the other of the same outline. Dimensions:

Greatest Width.	Height.
9.5 mm.	15 mm.
6.0 "	12 "

Occurrence.—Conemaugh Series, PINE CREEK LIMESTONE, Grant district, 0.7 mile south of Laurel Church; BRUSH CREEK LIMESTONE, Grant district, 1.2 miles southeast of Brandonville.

Collection.—West Virginia Geological Survey.

Family Discinidae

Genus ORBICULOIDEA D'Orbigny

Orbiculoidea missouriensis (Shumard)

Discina missouriensis. Shumard, 1858, St. Louis Acad. Sci., Trans., vol. i, p. 221.

Middle Coal Measures: Lexington and Charbonniere, Missouri.

Description.—This small species is represented in our collections by only three specimens*, of which the most perfect has the following dimensions: diameter, 4.5 mm., convexity, 1 mm., beak 1/6 diameter from posterior margin.

The beaks of these shells are not the highest points of the shell and are curved over toward the posterior margin and pointed downward. Girty has shown⁴ that the form and position of the beak are variable and that specimens from Missouri commonly identified as Shumard's species possess beaks as described above.

*Since this was written two larger specimens from the Pine Creek Limestone, Grant district, 0.8 mile south of Brandonville, have been found. They have the following dimensions: diameter, about 19 mm.; convexity, 5 mm. The beak is located about in the center. They resemble most nearly the shells figured by Whitfield as *Discina meekana*, Ohio Geol. Survey, vol. vii, pl. xi, figs. 1-3, but have a more central beak. They are less convex than specimens of *O. convexa* from the same locality and horizon.

4. U. S. Geol. Survey, 1910, Bull. 436, p. 23.

Occurrence.—Conemaugh Series, PINE CREEK LIMESTONE, Grant district, 0.7 mile south of Laurel Church; BRUSH CREEK LIMESTONE, Valley district, 2.1 miles east of Reedsville.

Collection.—West Virginia Geological Survey.

Orbiculoidea convexa (Shumard)

Plate xliii, Figs. 7, 8.

Discina convexa. Shumard, 1858, St. Louis Acad. Sci., Trans., vol. i, p. 221.

Upper Coal Measures: Valley of Verdigris river, Kansas.

Description.—"Upper valve broadly but somewhat prominently convex; subcircular in marginal outline; the height nearly equal to one-half the diameter; apex somewhat obtuse, but moderately prominent, situated at about one-third the diameter of the shell from its posterior margin; surface marked by the usual distinct, concentric lines of growth." White⁵, 1884. One exfoliated specimen shows the shape of the above description, but only a few of the lines of growth are preserved.

Occurrence.—Conemaugh Series, PINE CREEK LIMESTONE, Grant district, 0.8 mile south of Brandonville.

Collection.—West Virginia Geological Survey.

Family Strophomenidae.

Genus DERBYA Waagen.

Derbya crassa (Meek and Hayden)

Orthis umbraculum? Hall, 1852, Stansb. Expd. Great Salt Lake, p. 412, pl. iii, fig. 6.

Carboniferous: Missouri river above Fort Leavenworth.

Orthis umbraculum? Owen, 1852, Geol. Survey, Wisconsin, Iowa, and Minnesota, pl. v, fig. 11.

Carboniferous: Missouri river, near mouth of Keg creek, and at Council Bluffs.

5. Geol. Survey Indiana, 13th Report, p. 121.

Orthis arachnoidea. Roemer (non Phillips), 1852, Kreid. von Texas, p. 89, pl. xi, figs. 9a-b.

Carboniferous: San Saba valley, Texas.

Orthis arachnoidea. Hall, 1857, Mexican Boundary Survey, pl. xx, fig. 3.

Orthisina crassa. Meek and Hayden, 1858, Acad. Nat. Sci., Philadelphia, Proc., p. 261.

Coal Measures: Leavenworth, Kansas.

Description.—The Preston county specimens agree closely with the original description and figures. The average size is less than that given by Meek and Hayden, though specimens of that size are not rare.

Occurrence.—Conemaugh Series, AMES LIMESTONE, throughout the county, (c); PINE CREEK LIMESTONE, Grant district, 0.8 mile south of Brandonville, (a); BRUSH CREEK LIMESTONE, Grant district, 1.2 miles southeast of Brandonville, (c), 0.9 mile northeast of Bruceton Mills, and 0.9 mile west of Bruceton Mills, (c); Garrett county, Maryland, B. & O. R. R. cut, Hutton, (a).

Collections.—West Virginia Geological Survey and West Virginia University.

Family Productidae

Genus CHONETES Fischer de Waldheim

Chonetes granulifer Owen

Plate xliii, Figs, 2, 3, 4.

Chonetes granulifera. Owen, 1852, Geol. Survey, Wisconsin, Iowa, and Minnesota, Report, p. 583, pl. v, fig. 12.

Carboniferous limestone: Near mouth of Keg creek.

Description.—This abundant little species is represented in Preston county by small but typical specimens. The following series of 18 measurements exhibits the proportions of specimens of increasing length of hinge, but chosen otherwise at random:

Width at Hinge.	Height.	Width at Hinge.	Height.
mm.	mm.	mm.	mm.
14	8	9	5
14	7	7	5
13	8.5	6	4
13	7	6	3
12	7	5	3
11	7	4	3
11	6.5	3.5	2.3
11	5	2	1.5
10.5	6.5	1	0.75

These measurements are similar to those given by F. C. Greene⁶ of specimens from the Florena shales at Florena and Grand Summit, Kansas, with the exception that square forms have not been discovered by the writer in Preston county—but the small number of these young forms collected there does not warrant a conclusion from the absence of square forms—and that no individuals from this county were found having a length of more than 14 mm. In their small size they resemble those from the Conemaugh of Ohio as reported by Miss C. G. Mark.⁷

At only two localities in the county was this species found in the Brush Creek limestone. No specimen from these places exceeds 7 mm. in length of hinge line, but in Garrett county, Maryland, at Hutton, near the West Virginia State line, and 4 miles northwest of Oakland, both in the Mount Carmel syncline, specimens measuring 14 mm. were obtained from the Brush Creek limestone.

Occurrence.—Conemaugh Series, AMES LIMESTONE, very abundant throughout the county. BRUSH CREEK LIMESTONE, Grant district, 0.9 mile west of Bruceton Mills, (c); Valley district, Kingwood turnpike, 2.1 miles east of Reedsville, (c); Hutton, Garrett county, Md., (c); 4 miles northwest of Oakland, Garrett county, Md.

Collections.—West Virginia Geological Survey and West Virginia University.

Chonetes verneuillanus Norwood and Pratten.

Plate xliii, Figs. 5, 6.

Chonetes verneuillana. Norwood and Pratten, 1855, Acad. Nat.

6. Journal of Geology, 1908, vol. xvi, p. 658.

7. Geol. Survey Ohio, 1912, 4th ser. Bull. 17, p. 301.

Sci., Philadelphia, Jour., 2d ser., vol. iii, p. 26, pl. ii, figs. 6a-c. (Imprint of whole volume 1855.)

Coal Measures: Charbonniere, Missouri.

Description.—This species does not attain to the size of the preceding, and its average size is smaller by about 4 mm. length of hinge. It reaches its greatest development, both in size and numbers, in the highly calcareous Pine Creek limestone, and is smallest in the shaly phase of the Brush Creek. Measurements of 15 specimens follow:

Width at Hinge.	Height.	Width at Hinge.	Height.
mm.	mm.	mm.	mm.
11	6	8	4.5
9	6	7	4
9	5.5	7	4
9	5	6	3.5
8	5.5	4.5	3
8	5	4	2.5
8	5	3	2.5
8	4.5		

Occurrence.—Conemaugh Series, PINE CREEK LIMESTONE, Grant district, 0.7 mile south of Laurel Church, and 0.8 mile south of Brandonville, (a); BRUSH CREEK LIMESTONE, generally throughout the county, (c to rare).

Collections.—West Virginia Geological Survey and West Virginia University.

Genus PRODUCTUS Sowerby

Productus semireticulatus Martin

Plate xlii, Figs. 1, 2.

Anomites semireticulatus. Martin, 1809, Petref. Derb., pl. xxxii, figs. 1, 2; pl. xxxiii, fig. 4.

Productus semireticulatus. De Koninck, 1847, Monog. du Gen. Productus et Chonetes, p. 83, pl. viii, figs. 1a-h; pl. ix, figs. 1a-m; pl. x, figs. 1a-d.

Carboniferous: Bagdad, Harrisville, Cuyahoga, Zanesville, Flint Ridge, Greensburg, and Antrim, Ohio; near Louisville, Kentucky; near St. Louis and St. Charles,

Missouri; Leavenworth, on the Missouri river; Long Creek, Crawfordsville, and near New Harmony, Indiana; Sparta, Illinois; Bolivia, South America.

Description.—This widespread and well known species needs no description here. The specimens from Preston county are somewhat exfoliated, but show the characteristic reticulation in the umbonal region, the shallow mesial sinus, which is quite well marked on the majority of the shells, the small, fairly regular costæ, and a few spine bases.

Occurrence.—Conemaugh Series, PINE CREEK LIMESTONE, Grant district, 0.8 mile south of Brandonville, and 0.7 mile south of Laurel Church, (a).

Collections.—West Virginia Geological Survey and West Virginia University.

Productus cora d'Orbigny.

Plate xlii, Fig. 24.

Productus cora. D'Orbigny, 1842, Voyage dans l'Amerique Meridionale, vol. iii, pt. iv, p. 55.

Carboniferous: Above Patapatoni, on an island in Lake Titicaca; Yarbichambi.

Description.—This common and well known species is found in all the marine fossiliferous horizons of the Conemaugh in the county. The majority of our specimens are only poorly preserved, as fragments or casts, and it is highly probable that some may belong to the closely related species, *P. insinuatus*, and that, on account of the fragmentary nature of the shells, the characteristic median fold appearing on the anterior portion of shells of that species is not seen. However, as *P. cora* is by far the more common species of the two in adjoining regions⁸, and as several undoubted specimens of this species are included in our material, the remainder are referred to it.

Occurrence.—Conemaugh Series, AMES LIMESTONE, Portland district, east side of Cheat river, 0.6 mile east of Trowbridge.

8. Beede, West Virginia Geol. Survey, 1913, Report, Marion, Monongalia, and Taylor counties, p. 323; Raymond, Carnegie Mus., Annals, 1910, vol. vii, No. 1, p. 154.

near head of ravine; Reno district, 0.5 mile northwest of Fellows-ville, and roadside 2.6 miles east of Fellowsville, (c); PINE CREEK LIMESTONE, Grant district, 0.8 mile south of Brandonville, (a), and 0.7 mile south of Laurel Church; BRUSH CREEK LIMESTONE, Grant district, 1.2 miles southeast of Brandonville, (a).

Collection.—West Virginia Geological Survey.

Productus insinuatus Girty.

Plate xlii, Figs. 3. 4.

Productus acquicostatus. Hall and Clarke, 1892, Geol. Survey, New York, Pal., vol. viii, pt. i, pl. 17 A, figs. 22, 23.

Coal Measures: Nebraska.

Productus acquicostatus. Hall and Clarke, 1892, State Geologist New York, Eleventh Ann. Report, for 1891, pl. 22, figs. 11, 12.

Coal Measures: Nebraska.

Productus acquicostatus. Hall and Clarke, 1894, "Introduction to Study of Brachiopoda," pt. i, pl. 22, figs. 11, 12.

Coal Measures: Nebraska.

Productus cora var. *americanus*. Beede, 1900, Univ. Geol. Survey Kansas, Rept., vol. vi, p. 77, pl. 11, fig. 2.

Upper and Lower Coal Measures: Kansas City, Eudora, Anderson county, Kansas.

Productus cora var. *americanus*. Woodruff, 1906, Nebraska Geol. Survey, Rept., vol. ii, pt. ii, p. 270, pl. 11, fig. 2.

Carboniferous: Louisville, Nebraska.

Productus insinuatus. Girty, 1911, New York Acad. Sci., Annals, vol. xxi, p. 129.

Wewoka Formation: Oklahoma. (Type specimens from Kansas.)

Description.—Only one undoubted specimen of this species is in our collection. It shows the median fold or keel which chiefly distinguishes this from the preceding species. The keel originates at the highest point of the pedicle valve, and extends in a broad curve gradually increasing in height, above the more narrow curvature of the remainder of the shell, nearly to the anterior margin; at a point 5 mm. from the anterior margin the

keel loses its sharpness and becomes flattened on top; an inflection of the anterior margin makes a sinus in the outline which measures 7 mm. in length. Several fragments of shells of this type which are not of sufficient width to determine the presence or absence of a keel have been referred to *P. cora* on account of the nodes scattered over their surfaces from which spines arose. Girty notes the absence of these nodes as a feature of *P. insinuat*, but as the nodes are quite small, it is possible that they should be referred to the latter species.

Occurrence.—Conemaugh Series, PINE CREEK LIMESTONE, Grant district, 0.8 mile south of Brandonville.

Collection.—West Virginia Geological Survey.

Productus pertenuis Meek.

Plate xlii, Fig. 5.

Productus cancrini. Geinitz (non de Verneuil), 1866, Carb. und Dyas in Nebraska, p. 54, pl. 4, figs. 6 a-d.

Bed C: Nebraska City, Nebraska.

Productus pertenuis. Meek, 1872, U. S. Geol. Survey, Nebraska, Final Rept., p. 164, pl. 1, fig. 14; pl. 8, fig. 9.

Upper Coal Measures: Nebraska City and Brownsville, Nebraska; Grasshopper creek, 12 miles west of Leavenworth, and at Achison, Kansas.

Description.—This small species is found in all the marine horizons of the Conemaugh in the county, and is the smallest species of the genus in the series. Surface covered with fine radiating striæ and concentric wrinkles; small spines, regularly arranged, on some specimens; absence of spines probably due entirely to the state of preservation of the fossil, specimens from limestone having spines broken off when the fossil is separated from the rock, while casts in soft shales from which the shell has been leached usually show the cavities once filled by the spines.

Occurrence.—Conemaugh Series, AMES LIMESTONE, throughout the county, (c): PINE CREEK LIMESTONE, Grant district, 0.7 mile south of Laurel Church, (c); and 0.8 mile south of Brandonville. BRUSH CREEK LIMESTONE, Grant district, 0.9 mile west of

Bruceton Mills, 1.2 miles southeast of Brandonville, (c) ; Garrett county, Maryland, B. & O. R. R. cut at Hutton.

Collections.—West Virginia Geological Survey and West Virginia University.

***Productus nebraskensis* Owen.**

Plate xlii, Figs, 22, 23.

Productus nebraskensis. Owen, 1852, Geol. Survey Wisconsin, Iowa, and Minnesota, p. 584, pl. v, fig. 3.

Carboniferous limestone ; Bellevue, Missouri river, Nebraska.

Description.—The medium size, hinge line a little less than the greatest width of the shell, the unevenness of the surface due to the many spines of two sizes which have usually been lost, in our specimens, and the numerous raised, radiating lines which connect the spines, constitute a summation of features which serves to distinguish this species from any other in our collections ; represented chiefly by casts.

Occurrence.—Conemaugh Series, AMES LIMESTONE, Portland district, east side of Cheat river, 0.6 mile east of Trowbridge, near head of ravine ; Reno district, 2.6 miles east of Fellowsville, (a) ; PINE CREEK LIMESTONE, Grant district, 0.8 mile south of Brandonville, (a), and 0.7 mile south of Laurel Church, (a) ; BRUSH CREEK LIMESTONE, Grant district, 0.9 mile west of Bruceton Mills, (c), 2.1 miles north of Hopewell Church, (c), and 1.2 miles southeast of Brandonville, (a).

Collections.—West Virginia Geological Survey and West Virginia University.

***Productus symmetricus* McChesney.**

Plate xliii, Fig. 1.

Productus symmetricus. McChesney, 1860, New Pal. Foss., p. 35.

Upper Coal Measures : Lasalle and Springfield, Illinois.

Productus symmetricus. McChesney, 1865, Ill. New Spec. Foss., pl. i, figs. 9 a-b.

Description.—Represented in our collections chiefly by casts of the exterior of the brachial valve. From the preceding species, it may be distinguished by the larger size of mature individuals, the more regular arrangement of the spines, absence of connecting ridges, narrower umbo, and by the trifid cardinal process of the brachial valve, the corresponding structure in *P. nebraskensis* being bifid.

Occurrence.—Conemaugh Series, PINE CREEK LIMESTONE, Grant district, 0.8 mile south of Brandonville, (c); BRUSH CREEK LIMESTONE, Grant district, 0.9 mile east of Bruceton Mills, (c), 1.2 miles southeast of Brandonville, (c), and 0.9 mile northeast of Bruceton Mills; Valley district, 2.1 miles east of Reedsville, (a).

Collections.—West Virginia Geological Survey and West Virginia University.

Family Spiriferidae.

Genus SPIRIFER Sowerby.

Spirifer cameratus Morton

Plate xlii, Fig. 6.

Spirifer cameratus. Morton, 1836, American Jour. Sci., (1), vol. xxix, p. 150, pl. ii, fig. 3.

Coal Measures: Ohio Valley.

Description.—Casts of the interior and exterior of valves of this species are found at a few places, and show a width at the hinge of as much as 5.7 cm. and length of 3.5 cm. The plications are not so fine or so numerous as in some illustrations of the species, but agree well with those showing the coarser variation; e. g., Indiana Geol. Survey, 1883, 13th Rept., pl. xxxv, figs. 4 and 5, and Geol. Survey Ohio, 1913, 4th ser., Bull. 17, pl. xiv, figs. 1 and 2. Several casts of the interior of the pedicle valve were obtained and also young specimens similar to that figured by Beede, Univ. Geol. Survey, Kansas, vol. vi, pl. xii, fig. 5d.

Occurrence.—Conemaugh Series, PINE CREEK LIMESTONE, Grant district, 0.8 mile south of Brandonville, (c). BRUSH CREEK

LIMESTONE, Grant district, 1.2 miles southeast of Brandonville (young individuals); and 0.9 mile northeast of Bruceton Mills (young individual).

Collections.—West Virginia Geological Survey and West Virginia University.

Genus AMBOCOELIA Hall

Ambocoelia planiconvexa (Shumard)

Plate xlii, Figs. 17-21.

Spirifer planoconvexa. Shumard, 1855, Missouri Geol. Survey, 1st and 2d Ann. Reports, pt. 2, p. 202.

Upper Coal Measures: On Missouri river, near mouth of Platte river.

Description.—This abundant species is everywhere characteristic of the Ames limestone; both its presence and its profusion serve to distinguish the Ames from any other fossiliferous horizon in the county.

Occurrence.—Conemaugh Series, AMES LIMESTONE, throughout the county, (c to a).

Collections.—West Virginia Geological Survey and West Virginia University.

Family Athyridae.

Genus COMPOSITA Bronn

Composita subtilita (Hall)

Plate xlii, Figs. 7-16.

Terebratula roissyi. D'Orbigny (non L'Eveille), 1842, Voyage dans l'Amerique Meridionale, Pal., p. 46.

Carboniferous: Yarbichambi.

Terebratula permiana. D'Orbigny, 1847, Idem, vol. viii, pl. iii. (Geol.), figs. 17-19, (not *T. permiana*, pl. ii).

Terebratula plano-sulcata. Owen, 1852, Geol. Survey Wisconsin, Iowa, and Minnesota, pl. v, fig. 9.

Carboniferous limestone: Near Council Bluffs.

Terebratula subtilita. Hall, 1852, Stansbury's Exped. Great Salt Lake, p. 409, pl. ii, figs. 1a, b, 2a, b.

Carboniferous: Missouri river, near Weston.

Description.—This species, which has a very wide distribution in North America, is abundant at a few of the localities examined and in each of the fossiliferous, marine horizons in the Conemaugh of the county. Most of these specimens are of the broadly oval type, but a few of the narrower variety were found.

Many casts of the interiors of both the valves have been examined and several of each selected and illustrated to show the variation in the configuration of the visceral areas of the two valves. Spiralia not found preserved in any of our specimens.

Occurrence.—Conemaugh Series, AMES LIMESTONE, Reno district, 0.5 mile northwest of Fellowsville; PINE CREEK LIMESTONE, Grant district, 0.8 mile south of Brandonville, (a), and 0.7 mile south of Laurel Church, (a); BRUSH CREEK LIMESTONE, Grant district, 0.9 mile west of Bruceton Mills, (c), and 1.2 miles southeast of Brandonville; Valley district, 2.1 miles east of Reedsville, (a).

Collections.—West Virginia Geological Survey and West Virginia University.

MOLLUSCA

PELECYPODA

Family Solemyacidae

Genus SOLENOMYA Lamarek

Solenomya radiata (Meek and Worthen)

Solemya radiata. Meek and Worthen, 1860, Acad. Nat. Sci., Philadelphia, Proc., p. 457.

Coal Measures: Grayville, Illinois.

Solenomya radiata. Meek and Worthen, 1866, Illinois Geol. Survey, vol. ii, p. 349, pl. xxvi, figs. 10a, b.

Coal Measures: Schuyler county, Illinois.

Description.—This medium sized, solenoid shell with its flat, radiating plications is distinct from all other pelecypoda here described. Our specimens agree closely with the original description.

Occurrence.—Conemaugh Series, AMES LIMESTONE, Portland district, east side of Cheat river, 0.6 mile east of Trowbridge, near head of ravine; Reno district, 0.5 mile northwest of Fellowsville.

Collections.—West Virginia Geological Survey and West Virginia University.

***Solenomya soleniformis* Cox**

Solenimya solciformis. Cox, 1857, Kentucky Geol. Survey, vol. iii, p. 573, pl. ix, fig. 5.

Coal Measures: Union county, Kentucky.

Description.—"Transversely elongated; inequilateral; beaks not elevated, sloping to the front, about one-third the length from the anterior end; extremities and base obtusely rounded—more decided anteriorly in young than in adult specimens; cardinal border straight; surface covered with concentric lines and furrows; length 2.74 inches; width 1.45 inches." Cox, 1857.

We have only a single, imperfect specimen which shows the two shells together, but the posterior extremity is missing and the shells are crushed and distorted. However, the size and the character and outline of the concentric growth lines leave little doubt that it belongs to this species.

Length of the fragment, 55 mm.; probable length of shell, 68 mm.; probable height, 30 mm.

Occurrence.—Conemaugh Series, AMES LIMESTONE, Reno district, 0.5 mile northwest of Fellowsville.

Collection.—West Virginia Geological Survey.

Family Solenopsidae

Genus PROTHYRIS Meek

Prothyris elegans Meek

Prothyris elegans. Meek, 1871, American Jour. Conch., vol. vii, p. 8, pl. i, fig. 3.

Coal Measures: Nebraska City, Nebraska; Ohio; Illinois; Michigan.

Description.—This small shell is well represented in our collections and departs in no way from Meek's description.

Occurrence.—CONEMAUGH SERIES, AMES LIMESTONE, Portland district, 1.3 miles northeast of mouth of Roaring creek, and east side of Cheat river, 0.6 mile east of Trowbridge, near head of ravine, (c); Lyon district, 1.1 miles north of Newburg, Reno district, 0.5 mile northwest of Fellowsville, and 2.6 miles east of Fellowsville, (c); BRUSH CREEK LIMESTONE, Garrett county, Maryland, 4 miles northwest of Oakland.

Collections.—West Virginia Geological Survey and West Virginia University.

Genus SOLENOPSIS McCoy

Solenopsis solenoides (Geinitz)

Clidophorus solenoides. Geinitz, 1866, Carb. und Dyas in Nebr., p. 25, pl. ii, fig. 7.

Nebraska City: Nebraska.

Description.—A free translation of the original description of this species is as follows: "This small Solenoid shell is very much elongated, broadly and flatly arched, rounded anteriorly, posterior extremity slightly contracted and subtruncate. Ratio of length to greatest height, 4:1. The small, depressed beak is situated so near the anterior end that its position can scarcely be recognized except by a short furrow which this species exhibits on the inner border of the shell. Cardinal portion of shell posteriorly keel-like, anteriorly rounded, bearing 2-3 indistinct radiating lines which persist from the point of the beak to the pos-

terior end. Basal margin so broadly curved that for a short distance it runs almost parallel to the hinge line. Upper surface ornamented with faint, closely-placed, concentric lines of growth." Geinitz, 1866.

The Preston county shells agree closely with the above.

From the preceding species it may be told by its long and narrow shape, straight cardinal margin, and the presence of the little indentation near the beak. When the two shells are entire this indentation and the well defined notch of the anterior margin of *Prothyris elegans* readily separate them, but when the anterior margins are broken the difference in the striae has been found to be an excellent guide; the extremely fine, regular, closely-placed, and often nearly obsolete striae are distinct from the more coarse, irregular, more widely spaced, striae of the latter species. Both are fragile and often found broken.

Occurrence.—Conemaugh Series, AMES LIMESTONE, Reno district, 0.5 mile northwest of Fellowsville; BRUSH CREEK LIMESTONE, Grant district, 1.1 miles west of Clifton Mills.

Collection.—West Virginia Geological Survey.

Family Grammysiidae

Genus CHAENOMYA Meek

Chaenomya leavenworthensis (Meek and Hayden)

Allorisma ? leavenworthensis. Meek and Hayden, 1858, Acad. Nat. Sci., Philadelphia, Proc., p. 263.

Coal Measures: Leavenworth, Kansas.

Chaenomya leavenworthensis. Meek and Hayden, 1864, Smiths. Cont. Knowl., vol. xiv, No. 172, p. 43, pl. ii, figs. 1a-c.

Coal Measures: Leavenworth, Kansas.

Description.—This minutely papillose shell is represented by only a fragment of a small individual.

Occurrence.—Conemaugh Series, BRUSH CREEK LIMESTONE, Grant district, 0.9 mile northeast of Bruceton Mills.

Genus EDMONDIA De Koninck

A number of specimens of moderately convex, subelliptical.

concentrically striated, but nearly smooth, shells were obtained from a single locality in Reno district. They vary in ratio of length to breadth discontinuously from 1:1.35 to 1:1.75, and the position of the beak also varies discontinuously from a position equally distant from the lateral margins to one-fourth the length from the anterior end. Three forms have been separated from this material, one of which varies within narrow limits and apparently does not grade into the others, while the remaining two are each represented by a single imperfect specimen and their variations are therefore unknown. It has been thought profitable to describe these as separate species, although it may prove that they form parts of a continuous series when further work on adjoining areas is done. A specific name is here given only to the intermediate form, which is the only one of which we have enough specimens to judge of the variations with any degree of certainty.

The interiors of these shells are unknown and hence their generic relations are uncertain. They have been provisionally referred to *Edmondia*, as they most nearly resemble, exteriorly, species of that genus.

Edmondia ? *scutum*, sp. nov.

Plate xliii, Figs. 9, 10.

Description.—Five specimens, three of which are fragmentary, of a form which is only provisionally referred to the genus *Edmondia*, because the hinge and interior of the shell are unknown, seem to belong to no described species. They are all of very nearly the same type, with a slight variation in the proportion of length to height.

Shell subelliptical, ratio of height to length varies from 1:1.75 to 1:1.57; moderately convex in the umbonal and central regions, flattening posteriorly, more abruptly anteriorly, and curving evenly downward to the ventral margin, the curve being slightly convex the whole way; without defined umbonal ridges; basal margin forming a broad curve, nearly straight in the middle, rounding up suddenly into the anterior and posterior margins which are very nearly equally rounded; dorsal margin more straightened

along the middle than the ventral margin, rounding more suddenly into the lateral margins, without a defined escutcheon or lunule; beaks much depressed, obtuse, and rising only a very little above the hinge line, placed nearly half-way between the posterior and the anterior ends. Surface with fine, concentric, striae and rather numerous undulations of growth. Anterior margin above the middle slightly reflexed, as in *E. reflexa* Meek, from which our species differs in being less transverse and more subcircular.

Dimensions of three specimens:

Length	Height	Thickness (one valve)
22 mm.	14 mm.	3 mm.
21 "	12 "	
12 "	8.5 "	1.25 "

This fossil was first discovered by the writer in Garrett county, Maryland, while engaged in paleontological studies for the Maryland Geological Survey, and was given the manuscript name *E. garrettensis* in a dissertation submitted to the Johns Hopkins University.

Occurrence.—Conemaugh Series, AMES LIMESTONE, Reno district, 2.6 miles east of Fellowsville, (c).

Collection.—West Virginia Geological Survey.

Edmondia ? sp. 1.

Plate xliii, Fig. 11.

Description.—Associated with the foregoing species is a single valve of a shell in all respects similar to that except in being more nearly circular and in having the umbonal portion broken away. The outline is, however, preserved. On account of the difference in shape it is not here identified with *E. scutum*, and, as only the one imperfect specimen is in our possession, it is not given a specific name. It, however, in our judgment, is not referable to any described species.

Dimensions: Length, 19 mm., height, 14 mm. Ratio of length to height, 1 : 1.35.

Occurrence.—Conemaugh Series, AMES LIMESTONE, Reno district, 2.6 miles east of Fellowsville.

Collection.—West Virginia Geological Survey.

Edmondia ? sp. 2.

Description.—Associated with the two preceding species were found three specimens, which vary in ratio of length to height from 1 : 1.6 to 1 : 1.75, and whose beaks are situated at one-fourth the length from the anterior end. Slightly more quadrate in outline than *E. scutum*, but in other respects similar to that species with the above noted difference in the position of the beak.

Dimensions of three specimens:

Length.	Height.
20 mm.	11.5 mm.
11 "	7.0 " (Compressed shell, height restored).
7 " (Restored)	4.0 "

Occurrence.—Conemaugh Series, AMES LIMESTONE, Reno district. 2.6 miles east of Fellowsville.

Collection.—West Virginia Geological Survey.

Edmondia ? sp. indet. 1.

Description.—Two valves adhering at the hinges and spread out, but crushed and with the anterior ends broken, are preserved as casts of the interior of the shells, and show the groove near the hinge behind the beaks which is a feature of casts of *Edmondia*. The shell was of the oval type of the preceding species provisionally referred to this genus, and may have belonged to the species described as *E. scutum*, but, on account of the fragmentary condition of the casts, its relations cannot be determined with certainty.

Occurrence.—Conemaugh Series, BRUSH CREEK LIMESTONE, Grant district. 1.1 miles west of Clifton Mills.

Collection.—West Virginia Geological Survey.

Edmondia ? sp. indet. 2.

Description.—A single cast of a valve which appears to belong to none of the above described species of the genus *Edmondia*, but has apparently a large portion of the longer end

broken away, is in our collections. It has the more transverse shape of the form here designated as *Edmondia* *sp. 2*, but it is possible that it was as much produced as *E. reflexa* Meek. From *E. sp. 2* it differs in having the beak slightly more elevated, the shorter end nearly in line with the cardinal border, in which respect it resembles *E. reflexa* Meek. Surface showing concentric wrinkles of growth and the groove behind the beaks mentioned in the description of the preceding species. Another fragment of the same general shape is a cast of the exterior and shows fine, regular, closely-placed concentric markings.

Occurrence.—Conemaugh Series, PINE CREEK LIMESTONE, Grant district, 0.8 mile south of Brandonville.

Collection.—West Virginia Geological Survey.

Edmondia aspinwallensis Meek.

Plate xliii, Fig. 12.

Edmondia aspenwallensis. Meek, 1871, U. S. Geol. Survey Wyoming, Prelim. Rept., p. 299.

Upper Coal Measures: Aspenwall, Nebraska.

Edmondia aspinwallensis. Meek, 1872, U. S. Geol. Survey, Nebraska, Final Rept., p. 216, pl. iv, figs. 2a-c.

Upper Coal Measures: Aspinwall, Nebraska.

Lower Coal Measures: West Virginia.

Coal Measures: Illinois.

Description.—"Shell longitudinally subovate, moderately convex, the greatest convexity being a little in advance of and above the middle; base nearly semielliptic in outline; posterior side rather narrowly rounded, or sometimes very faintly subtruncate obliquely above; dorsal margin nearly straight just behind the beaks, but very gradually declining with a slightly convex outline posteriorly; anterior side quite short and declining very abruptly from the beaks above, and rounded below; beaks rather depressed, incurved, and located nearer the anterior end than the middle. Surface of cast with moderately distinct, irregular concentric undulations; showing behind the beaks distinct impressions of the cartilage fulcra.

"Length, 1.45 inches; height, 1.03 inches; convexity, about 0.68 inch." Meek, 1872.

Our specimens are casts of the interior with a few fragments of external casts. These show no traces of radiating lines noted on shells from Ohio."

Occurrence.—Conemaugh Series, BRUSH CREEK LIMESTONE, Grant district, 0.9 mile northeast of Bruceton Mills; Valley district, 2.1 miles east of Reedsville. (?)

Collections.—West Virginia Geological Survey and West Virginia University.

Edmondia ovata Meek and Worthen

Plate xliii, Fig. 14.

Edmondia ovata. Meek and Worthen, 1873, Geol. Surv. Illinois, vol. v, pl. 26, fig. 13.

Coal Measures.

Description.—The cast of the interior of a small shell with its outline corresponding very closely to that of the original figure of this species and with the regular concentric corrugations of growth apparently also similar is in our collection.

Length, 10 mm.; height, 6.5 mm.; convexity, 1.5 mm.

Occurrence.—Conemaugh Series, BRUSH CREEK LIMESTONE, Grant district, 0.9 mile west of Bruceton Mills.

Collection.—West Virginia Geological Survey.

Edmondia ovata var. *levis*, var. nov.

Description.—This shell is made a variety of *E. ovata* which it resembles, as far as we have been able to judge from its fragmentary condition, quite closely except that the surface is much more smooth than one would infer the surface of that species to be from a comparison with the figure of Meek and Worthen, which, however, represents an internal cast. The surface of our specimen is covered with fine, closely-placed, concentric striae, somewhat irregular in their relative strength, and occasional, stronger growth lines which give it a slightly wavy appearance and on the inner surface may have been as strong as those represented in the figure of *E. ovata* given by Meek and Worthen. In

9. Mark, C. G., Geol. Survey Ohio, 1913, 4th ser., Bull. 17, p. 305, pl. xiv, fig. 11.

the absence of exact knowledge on this last point we have made this a variety.

Our specimen has the anterior extremity partly broken away.

From *E. aspinwallensis* this shell is readily distinguished by its more produced posterior dorsal margin, which in the last named species falls away rapidly from the beak to the posterior margin, there being practically no posterior dorsal margin in that species.

Occurrence.—Conemaugh Series, AMES LIMESTONE, Portland district, east side of Cheat river, 0.6 mile east of Trowbridge, near head of ravine.

Collection.—West Virginia Geological Survey.

Edmondia gibbosa (McCoy)

Astarte gibbosa. McCoy, 1844, Syn. Carb. Foss. Ireland, p. 55, pl. viii, fig. 11.

Carboniferous: Ireland.

Description.—Several fragments show the regular, lamellose, concentric ridges of this species but are too poor to illustrate.

Occurrence.—Conemaugh Series, AMES LIMESTONE, Portland district, east side of Cheat river, 0.6 mile east of Trowbridge, near head of ravine, (c); Reno district, 0.5 mile northwest of Fellowsville, (?).

Collection.—West Virginia Geological Survey.

Family Nuculidae

Genus NUCULA Lamarck

Nucula anodontoides Meek

Plate xliii, Figs. 15, 16, 17.

Nucula (?) anodontoides. Meek, 1871, 3d Ann. Rept. Regents of West Virginia Univ., for 1870, "B," p. 71.

Coal Measures (Just below Mahoning sandstone): Monongalia county, W. Va.

Description.—"Shell ovate, ventricose, the greatest convexity being in the umbonal region; posterior side short, faintly sub-

truncate vertically at the immediate extremity; basal margin semi-elliptical in outline; cardinal margin nearly straight externally, equalling about half the length of the valves, carinate at the extremities; anterior side rather long, very narrowly rounded in the middle of the extremity, to which point the basal margin rounds up rather gradually, and the anterior dorsal edge slopes obliquely from the end of the hinge; beaks moderately prominent, convex, incurved without very distinct obliquity, and located about half-way between the middle and the posterior side; umbonal slopes, both before and behind, subangular, in consequence of the presence of a lunule and escutcheon-like impression, of which that on the anterior or longer side is larger, being usually continued nearly or quite to the extremity of that side. Surface smooth, or only showing under a magnifier very obscure lines of growth.

"Length of the largest specimen, 0.57 inch; height, 0.40 inch; convexity, 0.30 inch. Some of the other specimens are proportionally more convex.

"I have described the shorter side as the posterior of this shell, which, of course, would probably be incorrect, if it is not a true *Nucula*. Although I only know from some of the imperfect specimens that it has a rather coarsely crenate hinge, there can be little doubt that it has an internal ligament, and thus differs from *Tellinomya* and other paleozoic types that have been separated under other names, since the dorsal margin of the valves can be seen to fit closely all the way along, so as to show no traces of an external ligament. It has not the physiognomy of the typical modern *Nuculas*, but looks externally like a miniature *anodon*. It seems to be *closely* allied to *N. Beyrichi*, V. Schaur, from the Permian of Germany; but it is larger, more robust, more nearly smooth, and differs in the lunule-like impressions before and behind the beaks." Meek, 1871.

No very good casts of the interior of this shell are in our collection. Twelve teeth have, however, been counted anterior to the beak on one specimen and 5 posterior to the beak on another. Occasional wrinkles of growth, more strongly developed on the ventral portions of the shell, may be seen with the unaided eye.

Measurements of four specimens:

Length	Height	Convexity
13 mm.	9 mm.	7 mm.
13.5 "	9 "	7 "
13.5 "	9 "	7.5 "
14.5 "	9 "	8.5 "

Our specimens correspond closely with Meek's description quoted above. Shells from Ohio figured by Miss Mark¹⁰ differ from our specimens in having the middle of the anterior extremity less narrowly rounded, as was noted by Miss Mark as a difference between her specimens and Meek's description, in having the posterior extremity more narrowly rounded, and the subtruncation of this extremity only one-half so long as ours; our shell has the two extremities sub-equal in size, while the Ohio shell is markedly unequal at the ends. However, as the shape of the anterior extremity of the Ohio shells is said to vary from that represented by the figure continuously to a form corresponding to Meek's description, it may be that variations can be found with the posterior extremity likewise intermediate between the Ohio and the Preston county shells. Another difference noticeable between the last named is in the contour of the ventral margin, ours being much more convex, more evenly and symmetrically rounded, with no approach to a straight line as in the Ohio shell. It may be that these will prove on a comparison of the specimens to be different species.

A diligent search for Meek's type specimens, and for those of the other new species described in the report quoted above, in the collections of the U. S. National Museum by Dr. R. S. Bassler, Custodian of Invertebrate Paleontology of that institution, and the author failed to reveal them, although they are listed in the published catalogue of type invertebrate fossils of the Museum. It is feared that they have been lost.

Occurrence.—Conemaugh Series, AMES LIMESTONE, throughout the county, (a); BRUSH CREEK LIMESTONE, Grant district, 0.9 mile west of Bruceton Mills, 2.1 miles north of Hopewell Church, (c), and 0.9 mile northeast of Bruceton Mills (?); Garrett county, Maryland, 4 miles northwest of Oakland.

Collections.—West Virginia Geological Survey and West Virginia University.

10. Mark, C. G., Geol. Survey Ohio, 1913, 4th ser., Bull, 17. p. 306.

Nucula parva McChesney

Nucula parva. McChesney, 1860, Desc. New Pal. Foss., p. 54.
Coal Measures: Danville, Illinois.

Nucula parva. McChesney, 1865, Ill. New Spec. Foss., pl. ii.
figs. 8a-c.

Description.—"Shell minute, subtriangular, somewhat gibbous at the beaks, which are small, incurved, approximate, pointing toward and terminating the anterior extremity; cardinal line straight to near the beaks, where it is slightly curved downward, cardinal line and anterior slope are at right angles to each other. Ventral margin beautifully and gradually curving upward to the posterior, which is sharply rounded. Interior of the hinge unknown.

"Surface marked by comparatively coarse, regular, sharp, concentric striae.

"This shell has the general appearance of *N. shumardana* of Hall (Trans. Albany Inst., vol. iv, Nov. 1856), but differs from it entirely in the surface structure; that species being only finely striated, as are all shells of this class, when destitute of ornamental surface structure; while the markings of this species are of an ornamental nature, sufficiently strong to be considered of specific importance." McChesney, 1860.

This little species is a very common one. In form it varies from sub-triangular to subquadrate, the posterior margin being quite convex on some specimens. Casts of the interior of the shell show the teeth as in the illustration of Meek and Worthen.¹¹

Occurrence.—Conemaugh Series, AMES LIMESTONE, throughout the county, (a to aa); BRUSH CREEK LIMESTONE, Grant district, 0.9 mile west of Bruceton Mills, (c), and 0.9 mile northeast of Bruceton Mills; Garrett county, Maryland, 4 miles northwest of Oakland, and B. & O. R. R. cut at Hutton.

Collections.—West Virginia Geological Survey and West Virginia University.

11. Ill. Geol. Survey, 1873, vol. v, pl. xxvi, fig. 8b.

Subgenus ANTHRACONEILO Girty

Anthraconeilo taffiana Girty

Plate xliii, Fig. 18.

Anthraconeilo taffiana. Girty, 1911, N. Y. Acad. Sci., Ann., vol. xxi, p. 132.

Wewoka formation: Wewoka and Coalgate quadrangles, Oklahoma.

Description.—This large, transverse, rather convex shell is quite common in the Conemaugh limestones of the county. It answers closely to Girty's description in all the features which we have been able to observe. The dentition is well shown, but muscle markings and pallial line are not preserved. Exfoliated specimens show rounded, raised, growth lines with irregular, transverse wrinkles between them. Unworn specimens are nearly smooth with the concentric striae and stronger growth lines visible on close inspection.

Occurrence.—Conemaugh Series, AMES LIMESTONE, Portland district, east side of Cheat river, 0.6 mile east of Trowbridge, near head of ravine, (a); Reno district, 0.5 mile northwest of Fellowsville, (a); BRUSH CREEK LIMESTONE, Grant district, 1.1 miles west of Clifton Mills; Garrett county, Maryland, 4 miles northwest of Oakland, (a).

Collections.—West Virginia Geological Survey and West Virginia University.

Family Ledidae

Genus LEDA Schumacher

Leda bellistriata Stevens ?

Leda bellistriata. Stevens, 1858, American Jour. Sci., 2d ser., vol. xxv, p. 261.

Coal Measures: Danville, Illinois; Summit, Ohio.

Description.—Although about a dozen specimens from several localities have been collected they are all flattened and conse-

quently do not show the character of the lunule, and have the posterior extremity broken off. The surfaces are also imperfect, though the regular, concentric, raised, striae are apparent. It is, therefore, with a good deal of uncertainty that these shells are referred to this species. When more specimens can be examined, it may prove to be *L. arata*, which differs chiefly in the character of the lunule, position of the beaks, in being slightly more attenuate, and in the imbricated appearance of the striae.¹²

Occurrence.—Conemaugh Series, AMES LIMESTONE, Portland district, east side of Cheat river, 0.6 mile east of Trowbridge, near head of ravine, (c); Lyon district, 1.1 miles north of Newburg; Reno district, 0.5 mile northwest of Fellowsville, (c); PINE CREEK LIMESTONE, Grant district, 0.8 mile south of Brandonville; BRUSH CREEK LIMESTONE, Valley district, 2.1 miles east of Reedsville; Garrett county, Maryland, B. & O. R. R. cut at Hutton.

Collections.—West Virginia Geological Survey and West Virginia University.

Leda meekana Mark

Plate xliii, Figs. 19, 20.

Nucula kazanensis. Geinitz, 1866, Carb. und Dyas in Nebraska, p. 20, pl. 1, figs. 33, 34. (Not *N. kazanensis* de Verneuil, 1845.)

Nebraska City: Nebraska.

Nucula bellistriata var. *attenuata.* Meek, 1872, U. S. Geol. Survey, Nebraska, Final Rept., p. 206, pl. 10, figs. 11a, b.

Upper Coal Measures: Nebraska City, Nebraska; Leavenworth, Kansas; Iowa; Illinois.

Leda meekana. Mark, 1913, Geol. Survey Ohio, 4th ser., Bull. 17, p. 307, pl. xv, fig. 1.

Portersville limestone; Blue Rock Township, Muskingum county, and Portersville, Perry county.

Description.—Resembling *L. bellistriata* but smaller, more attenuate, with finer striae—8 striae in 1 mm., while *L. bellistriata* has 3 striae in the same distance—and not flattened by pressure, as are the specimens of the last named species in our collection.

12. Girty, 1899, U. S. Geol. Survey, 19th Ann. Rept., pt. iii, p. 581.

On casts of this shell have been counted as many as 15 hinge teeth.

Dimensions of 8 specimens:

Length	Height	Thickness of two valves
3 mm.	1.25 mm.	.....
7.5 "	3.5 "	.....
7.5 "	3.5 "	.....
7.5 "	4 "	3 mm.
9.5 "	4.25 "	.....
9.5 "	5 "	2.5 "
10 "	4.5 "	.....
11 "	5.5 "	.....

Occurrence.—Conemaugh Series, AMES LIMESTONE, Portland district, east side of Cheat river, 0.6 mile east of Trowbridge; Lyon district, 1.1 miles north of Newburg, (a); Reno district, 0.5 mile northwest of Fellowsville, (a); Valley district, 2.1 miles east of Reedsville; BRUSH CREEK LIMESTONE, Grant district, 0.9 mile west of Bruceton Mills, 2.1 miles north of Hope-well Church, (c), and 0.9 mile northeast of Bruceton Mills, (c). Garrett county, Maryland, B. & O. R. R. cut at Hutton.

Collections.—West Virginia Geological Survey and West Virginia University.

Family Parallelodontidae

Genus PARALLELODON Meek

Parallelodon sangamonensis (Worthen)

Macrodon sangamonensis. Worthen, 1890, Geol. Survey Illinois, vol. viii, p. 123, pl. xxi, figs. 3-3a.

Coal Measures: Rolls Ford, Sangamon county, Ill.

Description.—Several casts of shells of this species are in our possession and show the characteristic proportions and surface markings, but are too poorly preserved to be figured. The largest specimen has a length of 24 mm., but is so deformed by pressure that its other proportions may not be measured. Three, and possibly a fourth of less extent, parallel teeth are shown just below the hinge posterior to the beak and extend almost the entire length of the hinge line.

Occurrence.—Conemaugh Series, BRUSH CREEK LIMESTONE,

Grant district, 0.9 mile west of Bruceton Mills; Valley district, 2.1 miles east of Reedsville.

Collection.—West Virginia Geological Survey.

Parallelodon obsoletus (Meek)

Macrodon obsoletus. Meek, 1871, 3d Ann. Rept. Regents West Virginia University, for 1870, "B," p. 71

Lower Coal Measures: Monongalia county, W. Va.

Description.—"This species agrees very nearly with *M. (Arcu) carbonaria* of Cox, (Kentucky Report, Atlas pl. viii, fig. 5), excepting that it seems not to attain quite so large a size, and has radiating costae only on the posterior dorsal region; all the other parts of the valves being marked merely by concentric lines, and sometimes rather strong, irregular ridges and furrows of growth. These concentric striae cross the radiating lines of the posterior dorsal region, so as to form a subcancellated marking on that part of the valves.

"Length, 1 inch; height, 0.45 inch; convexity, about 0.26 inch."

From the preceding species this differs in being much smaller, in lacking the strong radiating striae, and mucronate posterior cardinal extremity of that species, as figured by Keyes.¹³ The anterior extremities also differ, as is shown by figures of the two species, that of *P. sangamonensis* rounds into the dorsal margin and meets it at an angle slightly greater than 90 degrees and has a truncated appearance, while that of *P. obsoletus*, although finally meeting the dorsal margin at 90 degrees, yet is, in the greater part of its extent, inclined to the dorsal margin at an acute angle, the most posterior point of the latter being situated on the dorsal margin, while in the former species it is situated on the posterior margin about midway of the shell.

Dimensions of largest specimen: Length, 9 mm.; height, 4 mm.; convexity, 1.5 mm.

The specimens figured are Meek's types, kindly loaned by the U. S. National Museum, which were collected by Prof. John J. Stevenson when a professor in the West Virginia University.

13. Missouri Geol. Survey, 1894, vol. v, pl. xlv. fig. 2.

Occurrence.—Conemaugh Series, BRUSH CREEK LIMESTONE, Grant district, 0.9 mile west of Bruceton Mills, (c).

Collection.—West Virginia Geological Survey.

Family Pinnidae

Genus AVICULIPINNA Meek

Aviculipinna americana Meek

Avicula pinnaciformis. Geinitz, 1866, Carb. und Dyas in Nebraska, p. 31, pl. ii, fig. 13. (Not *Solen pinnaciformis*, Geinitz, 1848.)

Nebraska City: Nebraska.

Aviculopinna Americana. Meek, 1867, American Jour. Sci., 2d ser., vol. xliiv, p. 282.

Aviculopinna Americana. Meek, 1872, U. S. Geol. Survey Nebraska, Final Rept., p. 197, pl. ix, figs. 12a-d.

Upper Coal Measures: Nebraska City, Nebraska; Iowa.

Description.—This determination is based on an internal cast of a small individual which shows the nearly terminal beak, the small lobe anterior to the beak, and concentric growth lines, which are very faint and almost obsolete upon the dorsal portion of the shell. These lines, where it is possible to trace their course upon the upper part of the shell, meet the hinge line at right angles. So far as can be determined, this shell agrees with the description and figures of *A. americana*. *A. illinoisensis* is said by Beede¹⁴ to have larger striae than this species and it is probable that they would likewise be stronger on the interior surface; also the dorsal margin of the last named is slightly curved, while that of our specimen is straight.

Length, 7 mm.; height, 2.25 mm.

Occurrence.—Conemaugh Series, AMES LIMESTONE, Reno district, 2.6 miles east of Fellowsville.

Collection.—West Virginia Geological Survey.

14. Univ. Geol. Survey Kansas, 1900, vol. vi, pt. ii, p. 144.

Family Myalinidae

Genus MYALINA de Koninck

Myalina perniformis Cox

Myalina perniformis. Cox, 1857, Kentucky Geol. Survey, vol. iii, p. 569, pl. viii, fig. 8.

Coal Measures: Providence, Hopkins county, Kentucky.

Description.—"Sub-quadrate; inequilateral; beak pointed, projecting beyond, and moderately curved over the cardinal border; cardinal border nearly straight; anterior margin and base rounded; posterior margin straight, near which a prominent ridge gradually slopes to the front and base; surface covered with strong concentric, somewhat fimbriating lines of growth; length 1.13 inches; width, 0.67 inch." Cox, 1857.

Although only the dorsal half of an interior cast of a right valve is in our collection, it very evidently belongs to this species. The dorsal margin makes an angle of about 65 degrees with the anterior margin.

Length, 7 mm.; height, unknown.

Occurrence.—Conemaugh Series, AMES LIMESTONE, RENO district, 2.6 miles east of Fellowsville.

Collection.—West Virginia Geological Survey.

Myalina sp.

Description.—Shape very similar to *M. subquadrata*; beak broken, but apparently pointed; surface covered with strong, coarse, imbricating, concentric lamellae which are thin and each projecting considerably beyond and over the next succeeding. Interior of the shell, as known from a single cast, apparently also strongly marked by the concentric lamellae, and not at all smooth as in *M. subquadrata*. This appearance is hardly the result of exfoliation, as the exterior would likewise be exfoliated, in which case the delicate, projecting lamellae would have certainly been broken away.

This shell resembles in its exterior markings one which has about the dimensions of *M. subquadrata* which we have seen in

the collections of the U. S. Geological Survey, which Dr. Girty has so kindly allowed the author to study. Until better material is at hand, we do not venture to describe this as a new species, but it seems likely that it will prove to be such.

Family Trigoniidae

Genus SCHIZODUS King

Schizodus affinis Herrick ?

Schizodus affinis. Herrick, 1887, Bull. Dennison Univ., vol. ii, p. 41, pl. iv, figs. 22, 22a.

Coal Measures: Flint Ridge, Ohio.

Description.—Several fragments of shells probably referable to this rather variable species are in our collection, but are too poor to warrant a description.

Occurrence.—Conemaugh Series, AMES LIMESTONE, Portland district, east side of Cheat river, 0.6 mile east of Trowbridge, near head of ravine; Reno district, 0.5 mile northwest of Fellowsville; BRUSH CREEK LIMESTONE, Valley district, 2.1 miles east of Reedsville.

Collection.—West Virginia Geological Survey.

Schizodus sp. indet.

Description.—A fragment of a shell of this genus in our collection is too poor to determine its specific relations. It is of medium size, convex, and suggests *S. ulrichi*, but is broken posteriorly and it is impossible to say whether it was as much produced there as that species is.

Occurrence.—Conemaugh Series, AMES LIMESTONE, Portland district, east side of Cheat river, 0.6 mile east of Trowbridge, near head of ravine.

Collection.—West Virginia Geological Survey.

Family Pectinidae

Genus AVICULIPECTEN McCoy

Aviculipecten rectilaterarius (Cox)

Avicula recta-laterarea. Cox, 1857, Kentucky Geol. Survey, vol. iii, p. 571, pl. ix, fig. 2.

Coal Measures: Union county, Kentucky; Gallatin county, Illinois.

Description.—This medium sized, thin shelled species is not represented by good specimens in our collection. The flat, sub-quadrate shape, irregular, radiating grooves and straight hinge line equalling the greatest length of the shell, with its thin, fragile shell, serve to distinguish this species from others of this and associated genera.

A. whitei, judging by the description and figures, differs from this species in having the radiating striae fainter and the concentric growth lines more strongly developed. Concentric growth lines are faint on our shells.

Occurrence.—Conemaugh Series, AMES LIMESTONE, Portland district, east side of Cheat river, 0.6 mile east of Trowbridge, near head of ravine; Lyon district, 1.1 miles north of Newburg; Reno district, 0.5 mile northwest of Fellowsville, (c); BRUSH CREEK LIMESTONE, Garrett county, Maryland, 4 miles northwest of Oakland.

Collections.—West Virginia Geological Survey and West Virginia University.

Aviculipecten hertzeri Meek

Aviculopecten (Streblopteria ?) hertzeri. Meek, 1871, Acad. Nat. Sci., Philadelphia, Proc., p. 61.

Lower Coal Measures: Newark, Ohio.

Aviculopecten (Streblopteria ?) Hertzeri. Meek, 1875, Geol. Surv. Ohio, vol. ii, p. 330, pl. xix, figs. 13a-c.

Lower Coal Measures: Newark, Ohio.

Description.—¹⁵We have in our collection casts of the interior and exterior of both a right and a left valve of a shell of the proportions and outline of Meek's species. The surface of the exterior of both valves is covered with striae in two series, one concentric, imbricated, becoming coarser toward the ventral margin, the other radiating, equal in strength to the first on the upper portion of the shell, but becoming relatively weaker on the lower portion.

Length, 25 mm.; height, 24 mm.

Occurrence.—CONEMAUGH SERIES, BRUSH CREEK LIMESTONE, Grant district, 0.9 mile west of Bruceton Mills; Valley district, 2.1 miles east of Reedsville.

Collection.—West Virginia Geological Survey.

Aviculipecten pellucidus Meek and Worthen

Aviculopecten pellucidus. Meek and Worthen, 1860, Acad. Nat. Sci., Philadelphia, Proc., p. 455.

Coal Measures: Adams county, Illinois.

Aviculopecten pellucidus. Meek and Worthen, 1866, Illinois Geol. Survey, vol. ii, p. 327, pl. xxvi, figs. 5a, b.

Description.—This small, pectinoid shell may be distinguished from the other small shells of this genus found in the county by the two systems of fine striae which cover the surface with a rectangular network of lines; one system consists of radiating striae of equal size and the other of slightly finer concentric striae which on exfoliated specimens may be almost or entirely wanting. Subovate or subcircular in outline; anterior ear small triangular, separated from the anterior edge by a broad, subangular sinus; posterior ear about the same size as the other, flat, terminating in an acute angle, separated from posterior margin by a broad, shallow sinus.

Represented in our collections by casts of the interior and exterior of the valves.

15. *Pseudomonotis hazeni* (?), Keyes, Missouri, Geo. Survey, 1894 vol. v, pl. xlii, fig. 4 from the Upper Coal Measures, as figured, resembles this species except for the oval area extending from the beak to the middle of the shell and apparently with the radial striae obsolete there. If this is an accidental feature, the shell would seem to belong to this species.

Occurrence.—Conemaugh Series, BRUSH CREEK LIMESTONE, Grant district, 0.9 mile west of Bruceton Mills, (c), 1.1 miles west of Clifton Mills, and 0.9 mile northeast of Bruceton Mills.

Collections.—West Virginia Geological Survey and West Virginia University.

Subgenus ACANTHOPECTEN Girty

Acanthopecten carboniferous (Stevens)

Pecten carboniferous. Stevens, 1858, American Jour. Sci., 2d ser., vol. xxv, p. 261.

Coal Measures: Crooked Creek, Marion county, Illinois.

Description.—"Shell sub-orbicular. Hinge line straight, auricled. Anterior auricle equal to the anterior width of the shell. Posterior auricle wanting in the specimen, what portion left is rugose. Right valve: beak acute, appressed to the hinge line, polished. Disk rounded, surface marked by 15 acute ribs, which are ornamented with three series of sharp and more than semi-circular scollops, of which the first and more robust series are at the ventral margin, the second is not far removed, the distance of the third and lightest series is from the second double that of the second from the first. Umbone and apex smooth and polished.

"Length, 0.45 inch; height, 0.35 inch." Stevens, 1858.

Our specimens are all casts of the interior and of the exterior, the shell having been leached out. They agree closely with the descriptions.

Occurrence.—Conemaugh Series, AMES LIMESTONE, Reno district, 2.6 miles east of Fellowsville, (c); PINE CREEK LIMESTONE, Grant district, 0.8 mile south of Brandonville; BRUSH CREEK LIMESTONE, Grant district, 0.9 mile west of Bruceton Mills, and 1.2 miles southeast of Brandonville; Valley district, 2.1 miles east of Reedsville, (c).

Collections.—West Virginia Geological Survey and West Virginia University.

Genus DELTOPECTEN Etheridge

Deltopecten occidentalis (Shumard)

Pecten occidentalis. Shumard, 1855, Missouri Geol. Survey, Ann. Repts., i and ii, p. 207, pl. C, fig. 18.

Coal Measures: Near Plattsburg, Clinton county, Missouri

Description.—This species may be readily distinguished from other species of pectinoids in the area under consideration by its large size, regular radiating striae which alternate in size, and are crossed by fine, closely placed, concentric striae. Only a few imperfectly preserved specimens of mature growth are in our collections, but a large number of small specimens with the characteristics of the species are connected by almost insensible gradations with the larger so that there seems to be no doubt but they are the young of this species.

Occurrence.—CONEMAUGH Series, AMES LIMESTONE, Portland district, east side of Cheat river, 0.6 mile east of Trowbridge, near head of ravine, (a); RENO district, 0.5 mile northwest of Fellowsville, and 2.6 miles east of Fellowsville, (a); PINE CREEK LIMESTONE, Grant district, 0.8 mile south of Brandonville; BRUSH CREEK LIMESTONE, Grant district, 2.1 miles north of Hopewell Church, 1.2 miles southeast of Brandonville, and 0.9 mile northeast of Bruceton Mills, (c); Valley district, 2.1 miles east of Reedsville, (a).

Collections.—West Virginia Geological Survey and West Virginia University.

Genus EUCHONDRIA Meek

Euchondria neglecta (Geinitz)

Pecten neglectus. Geinitz, 1866, Carb. und Dyas in Nebraska, p. 33, pl. ii, fig. 17.

Nebraska City, Nebraska.

Description.—A free translation of Geinitz's description follows: "A small, nearly symmetrical, smooth-shelled species, which corresponds in Nebraska to *Pecten pusillus* of the Zechstein of Germany and England. Shell as broad as long, greatest

length, however, below the middle for the sides are somewhat more produced than is the case with *P. pusillus*. Ventral margin semicircular. The shell is much more compressed than *P. pusillus*, and its anterior margin is sharply truncated. Anterior ear somewhat acutely pointed and slightly produced; posterior ear large, its lateral margin making an obtuse angle with the cardinal border. Both ears, which are relatively large, as in *P. pusillus*, ornamented by several radiating lines, in which is an essential difference from that species. Height, as much as 6 mm." Geinitz, 1866.

This tiny shell was more fully described by Meek¹⁶, who noted that the surface, as known from casts and a few fragments of the shell, was "apparently only marked by fine concentric striae," but later by Meek and Worthen¹⁷, who state that the fine concentric striae are "crossed by still more minute radiating lines on the body part of the valve." Our shells, which are casts of the interior and exterior of both valves, show that the absence of radiating striae is due to exfoliation, the better preserved shells having both series of lines. The surface of good casts has the appearance of an extremely finely woven net, with pits between the raised lines of the cast.

Occurrence.—Conemaugh Series, PINE CREEK LIMESTONE, Grant district, 0.9 mile south of Brandonville; BRUSH CREEK LIMESTONE, Grant district, 0.9 mile west of Bruceton Mills, and 0.9 mile northeast of Bruceton Mills, (c).

Collections.—West Virginia Geological Survey and West Virginia University.

Family Limidae

Genus LIMA Bruguiere

Lima retifera Shumard

Plate xliii, Fig. 23.

Lima retifera. Shumard, 1858, St. Louis Acad. Sci., Trans., vol. 1, p. 214.

16. *Arculopecten neglectus*. Meek, 1872, U. S. Geol. Survey Nebraska, Final Rept., p. 193, pl. ix, figs. 1a, b. Nebraska City, Nebraska; Upper and Lower Coal Measures: Illinois.

17. Meek and Worthen, 1873, Geol. Survey Illinois, vol. v, p. 589, pl. xxvi, fig. 7. Upper and Lower Coal Measures: Illinois.

Coal Measures: Valley of Verdigris, Kansas.

Description.—"Shell inequilateral, rather small, sub-ovate, oblique, somewhat compressed, convex, height greater than the width; *cardinal margin* short, straight, forming with the buccal margin rather more than a right angle; *buccal* and *palleal* margins rounded; *anal* margin oblique; slightly concave; posterior umbonial slope falling rather abruptly to the ear, which is obtusely angulated, rather small and slightly recurved; anterior ear small, not ribbed, triangular, its cardinal border incurved; beak small, obtusely pointed, passing beyond the cardinal edge, and situated a little in advance of the same; surface of left valve marked with fine, concentric striae, and about twenty-five distinct, angulated, sub-equidistant, radiating ribs, which usually bifurcate anteriorly, and are simple behind: in the anterior umbonial slope the ribs are distinct, and on the posterior entirely wanting.

Dimensions.—Height of left valve, 0.64; length of same, 0.54; thickness of same, 0.12; length of cardinal edge, 0.25." Shumard, 1858.

Occurrence.—Conemaugh Series, AMES LIMESTONE, Lyon district, 1.1 miles north of Newburg; Reno district, 0.5 mile northwest of Fellowsville.

Collections.—West Virginia Geological Survey and West Virginia University.

Family Pholadellidae

Genus ALLERISMA King

Allerisma terminale Hall

Allerisma terminalis. Hall, 1852, Stansbury's Exped. Great Salt Lake, p. 413, pl. ii, figs. 4a, b.

Carboniferous: Big Blue river.

Description.—"Shell oval-ovate, rounded before and gradually narrowing behind the beaks (posterior extremity broken off); beaks prominent, closely incurved; posterior lunule elongated and distinctly defined; surface marked by distinct (rather sharp where unworn) equal concentric ridges, scarcely so wide

as the furrows between them. The ridges, when seen in a longitudinal direction, have an imbricated appearance." Hall, 1852.

Length, 70 mm.; height, 17 mm.; convexity, 21 mm. Dimensions of a young specimen: Length, 14 mm.; height, 10 mm.; convexity, 4 mm.

This large shell grows proportionally longer with age. The "lunule" of Hall's description is not, properly speaking, a lunule, but merely an undefined excavation. Our specimens are quite flat in the dorsal region; this is probably not a constant feature, but possibly due to flattening by pressure, although there is no evidence of the shell having been crushed.

Occurrence.—Conemaugh Series, BRUSH CREEK LIMESTONE, Grant district, 1.2 miles southeast of Brandonville, (c).

Collections.—West Virginia Geological Survey and West Virginia University.

Family Pleurophoridae

Genus PLEUROPHORUS King

Pleurophorus occidentalis Meek and Hayden

Plate xliii, Figs. 21, 22.

Pleurophorus occidentalis. Meek and Hayden, 1858, Albany Inst., Trans., vol. iv, p. 80.

Permian: In Nebraska on Missouri, opposite north Missouri boundary.

Pleurophorus occidentalis. Meek and Hayden, 1864, Pal. Upper Missouri, Smiths. Cont. Knowl., vol. xiv, pt. ii, p. 35, pl. i, figs. 11a, b.

Coal Measures: Nebraska, nearly opposite northern boundary of Missouri.

Description.—"Shell small, narrow, somewhat elongate, valves moderately convex along the umbonal slopes. Basal and dorsal margins nearly straight and subparallel, or converging slightly toward the front; posterior side rounded and rather compressed; anterior side rounding up gradually from the base. Beaks small, depressed and located at the anterior extremity;

hinge line long and straight. Surface with a few concentric marks, and traces of finer lines of growth, which are crossed by some four or five small faintly defined radiating costae, extending from the beaks obliquely backwards and downwards to the posterior and posterior-basal margins.

"Length, 0.37 inch; height, 0.16 inch; breadth, or convexity of the two valves, about 0.14 inch." Meek and Hayden, 1858.

The Preston county representatives of this small species are closely similar to the above description, and, in outline, to the published figures with the correction noted by Meek in his Nebraska report¹⁸ that his figure in the Upper Missouri report represents the shell as too much pointed anteriorly. The figures which we have seen do not show the described radiating ridges. These are, on our shells, at times nearly obsolete, but usually showing the number as above. Posterior to the beak and extending to the posterior end is a long, narrow, lanceolate lunule, the ventral side of which is only slightly convex.

Occurrence.—CONEMAUGH Series, AMES LIMESTONE, Portland district, east side of Cheat river, 0.6 mile east of Trowbridge, near head of ravine, (a); LYON district, 1.1 miles north of Newburg, (a); RENO district, 0.5 mile northwest of Fellowsville; BRUSH CREEK LIMESTONE, Grant district, 2.1 miles north of Hopewell Church; Garrett county, Maryland, B. & O. R. R. cut at Hutton.

Collections.—West Virginia Geological Survey and West Virginia University.

Genus PLEUROPHORELLA Girty

Pleurophorella geinitzi (Meek)

Allorisma elegans. Geinitz, 1866, Carb. und Dyas in Nebraska, p. 13, pl. i, fig. 31, (not *A. elegans* King, 1844).
Nebraska City, Nebraska.

Allorisma (Sedgwickia) Geinitzi. Meek, 1872, U. S. Geol. Survey Nebraska, Final Rept., p. 219, pl. x, figs. 16a, b.
Upper Coal Measures: Nebraska City, Nebraska.
Upper, Middle and Lower Coal Measures: Illinois.

18. U. S. Geol. Survey Nebraska, 1872, Final Rept., p. 213.

Description.—This small shell may be distinguished from the other Pleurophoroid species here described by its narrowed posterior end, more strongly carinate posterior umbonal slope, and the minute granules which cover the surface, being coarser arranged in radiating lines on the umbones and other parts of the valves in front of the angular umbonal slope. The granules of this species are coarser and less regularly arranged than those of *Chaenomya leavenworthensis*.

Largest example measures: Length, 9 mm.; height, 6 mm. As it is somewhat flattened by pressure its height may be exaggerated. A more perfect shell measures: Length, 7 mm.; height, 5.5 mm.; convexity, 1.75 mm.

Occurrence.—CONEMAUGH Series, AMES LIMESTONE, Portland district, east side of Cheat river, 0.6 mile east of Trowbridge, near head of ravine, (c); LYON district, 1.1 miles north of Newburg, (c); BRUSH CREEK LIMESTONE, Garrett county, Maryland, B. & O. R. R. cut at Hutton.

Collections.—West Virginia Geological Survey and West Virginia University.

Genus ASTARTELLA Hall

Astartella concentrica (Conrad)

Nuculites concentrica. Conrad, 1842, Acad. Nat. Sci., Philadelphia, Jour., 1st ser., vol. viii, p. 248.

Carboniferous System.

Edmondia concentrica. McChesney, 1865, Ill. New Spec. Foss., pl. ii, figs. 21a, b.

Description.—"Subtriangular, slightly ventricose, with rather distant sharp concentric striae; umbonal slope obtusely angulated; posterior dorsal margin rectilinear, very oblique; posterior extremity truncated, the margin nearly direct; beaks near the anterior extremity; basal margin nearly straight in the middle." Conrad, 1842.

This little shell is rather variable in shape, subtriangular and subquadrate specimens occurring together at several localities.

Occurrence.—CONEMAUGH Series, AMES LIMESTONE, Portland district, east side of Cheat river, 0.6 mile east of Trowbridge, near head of ravine; BRUSH CREEK LIMESTONE, Grant district

0.9 mile west of Bruceton Mills, (a); 1.1 miles west of Clifton Mills, and 0.9 mile northeast of Bruceton Mills, (a); Valley district, 2.1 miles east of Reedsville, (a); Garrett county, Maryland, B. & O. R. R. cut at Hutton.

Collections.—West Virginia Geological Survey and West Virginia University.

Pelecypod indet. 1.

Description.—A medium sized, oval, moderately gibbous pelecypod of the general appearance of an *Edmondia*; transversely oval, ventral margin nearly straight, rounding up gradually and evenly into the anterior and posterior extremities; posterior (?) end sub-truncate, inclined slightly backward to the dorsal margin; dorsal margin nearly straight and subparallel to the ventral margin; anterior end more narrowly rounded than the posterior, curving more abruptly into the dorsal than into the ventral margin. Beak situated about one-third the length from the anterior (?) end, small, and apparently curved slightly over the dorsal margin. Greatest convexity about half-way between the ends, but slightly nearer the dorsal than to the ventral margin.

Surface of shell, as seen from a cast, covered with fine, concentric striae and a few larger undulations of growth, which are not strongly developed except on the umbonal portion of the two interior casts which apparently belong to the same species.

Dimensions: Length, 36 mm.; height, 22 mm.; convexity, 6 mm.

Occurrence.—Conemaugh Series, BRUSH CREEK LIMESTONE, Garrett county, Maryland, 4 miles northwest of Oakland.

Collection.—West Virginia Geological Survey.

Pelecypod indet. 2.

Description.—Several fragments of casts of shells apparently very similar to the preceding species, but of a larger size, and probably a less transverse shape, cannot be identified. They are associated with the preceding species.

SCAPHOPODA

Family Dentaliidae

Genus *PLAGIOGLYPTA* Pilsbry and Sharp*Plagioglypta meekana* (Geinitz)

Dentalium Meekianum. Geinitz, 1866, Carb. und Dyas in Nebraska, p. 13, pl. i, fig. 20.

Nebraska City, Nebraska.

Description.—A translation of Geinitz's description follows: "This only slightly curved shell has a circular cross-section and increases rapidly in size, so that a specimen of 6 mm. length is enlarged from 0.3 mm. to 1.0 mm. at the larger end. The whole surface is covered by fine, regular, closely crowded lines of growth, 12 of which occupy the space of 1 mm."

From Geinitz's figure, as was pointed out by Meek, U. S. Geol. Survey of Nebraska, p. 224, the lines of growth are moderately distinct, passing obliquely around, with, at regular intervals, a deeper sulcus, but not spirally arranged, as the figure might lead one to expect. Our three specimens are casts with the shell leached out. One of these shows, on the interior of the shell, only the more marked "sulci" to have left an impression.

Length of the largest specimen, 16 mm.; width, at smaller end, 0.75 mm., at larger end, 2.0 mm.

Occurrence.—Conemaugh Series, PINE CREEK LIMESTONE, Grant district, 0.8 mile south of Brandonville; BRUSH CREEK LIMESTONE, Grant district, 0.9 mile northeast of Bruceton Mills; Valley district, 2.1 miles east of Reedsville.

Collection.—West Virginia Geological Survey.

GASTROPODA

Family Bellerophontidae

Genus *BELLEROPHON* Montfort*Bellerophon crassus* var. *wewokanus* Girty

Bellerophon crassus var. *wewokanus*. Girty, 1911, New York Acad. Sci., Ann., vol. xxi, p. 138.

Wewoka formation: Wewoka and Coalgate quadrangles, Oklahoma.

Occurrence.—Conemaugh Series, AMES LIMESTONE, Portland district, 0.6 mile east of Trowbridge; Reno district, 0.5 mile northwest of Fellowsville; BRUSH CREEK LIMESTONE, Garrett county, Maryland, B. & O. R. R. cut at Hutton, (c).

Collections.—West Virginia Geological Survey and West Virginia University.

Genus PATELLOSTIUM Waagen (emend. Ulrich)

Patellostium montfortianum (Norwood and Pratten)

Bellerophon Montfortianum. Norwood and Pratten, 1855, Acad. Nat. Sci., Philadelphia, Jour., 2d ser., vol. iii, p. 74, pl. ix, figs. 5a-c.

Coal Measures: Galatia, Illinois, and 5 miles below New Harmony, Indiana.

Occurrence.—Conemaugh Series, AMES LIMESTONE, Portland district, 0.6 mile east of Trowbridge, (aa); Lyon district, 1.1 miles north of Newburg, (a); Reno district, 0.5 mile northwest of Fellowsville, (aa); BRUSH CREEK LIMESTONE, Grant district, 0.9 mile northeast of Bruceton Mills, (c); Garrett county, Maryland, 4 miles northwest of Oakland, (c), and B. & O. R. R. cut at Hutton, (c).

Collections.—West Virginia Geological Survey and West Virginia University.

Genus EUPHEMUS McCoy

Euphemus carbonarius (Cox)

Bellerophon Urii. Norwood and Pratten, 1855, Acad. Nat. Sci., Philadelphia, Jour., 2d ser., vol. iii, p. 75, pl. ix, figs. 6a-c. (Not *B. urii* Fleming, 1828).

Coal Measures: Galatia and Grayville, Illinois; and 5 miles below New Harmony, Indiana

Description.—Our shells are entirely characteristic forms of this species. One specimen is exfoliated on the smooth portion

of the shell nearest the aperture and shows well the growth lines curving inward at the slit band.

Occurrence.—Conemaugh Series, AMES LIMESTONE, throughout the county, (aa); BRUSH CREEK LIMESTONE, Grant district, 0.7 mile south of Laurel Church, (c), 0.9 mile northeast of Bruce-ton Mills; Garrett county, Maryland, 4 miles northwest of Oakland, (c), and B. & O. R. R. cut at Hutton, (c).

Collections.—West Virginia Geological Survey and West Virginia University.

Genus BUCANOPSIS Ulrich

Bucanopsis perlata (Conrad)

Bellerophon perlatus. Conrad, 1842, Acad. Nat. Sci. Philadelphia, Jour., 1st ser., vol. viii, p. 270.

Carboniferous: Inclined plane of Allegany Mountains.

Bellerophon Marconianus. Geinitz, 1866, Carb. und Dyas in Nebraska, p. 7, pl. i, fig. 12.

Nebraska City, Nebraska.

Occurrence.—Conemaugh Series, AMES LIMESTONE, Portland district, 0.6 mile east of Trowbridge, (c); Reno district, 0.5 mile northwest of Fellowsville, (a); BRUSH CREEK LIMESTONE, Garrett county, Maryland, 4 miles northwest of Oakland, and B. & O. R. R. cut at Hutton.

Collections.—West Virginia Geological Survey and West Virginia University.

Bucanopsis kansasensis (Shumard)

Bellerophon Kansasensis. Shumard, 1858, St. Louis Acad. Sci., Trans., vol. i, p. 204.

Upper Coal Measures: Valley of the Verdigris, Kansas.

Occurrence.—Conemaugh Series, AMES LIMESTONE, Portland district, 0.6 mile east of Trowbridge; Reno district, 0.5 mile northwest of Fellowsville; BRUSH CREEK LIMESTONE, Garrett county, Maryland, 4 miles northwest of Oakland.

Collections.—West Virginia Geological Survey and West Virginia University.

Bucanopsis ? sp.

Description.—Two fragments of a large shell much expanded at the aperture have the general appearance of shells of this genus and are related to *B. perlata* in the surface ornamentation, which consists of fine revolving lines crossed by fainter growth lines. The revolving lines are slightly more coarse than those of that species.

Occurrence.—Conemaugh Series, AMES LIMESTONE, Reno district, 0.5 mile northwest of Fellowsville; Portland district, 1.3 miles northeast of mouth of Roaring creek; BRUSH CREEK LIMESTONE, Valley district, 2.1 miles east of Reedsville.

Collection.—West Virginia Geological Survey.

Genus PHARKIDONOTUS Girty

Pharkidonotus percarinatus (Conrad)

Bellerophon percarinatus. Conrad, 1842, Acad. Nat. Sci., Philadelphia, Jour., 1st ser., vol. viii, p. 268, pl. xvi, fig. 5.

Carboniferous: Inclined plane of the Alleghany Mts., in black shale overlying the stratum of coal No. 7.

Occurrence.—Conemaugh Series, AMES LIMESTONE, Reno district, 0.5 mile northwest of Fellowsville; BRUSH CREEK LIMESTONE, Grant district, 0.9 mile west of Bruceton Mills, (c); Valley district, 2.1 miles east of Reedsville.

Collections.—West Virginia Geological Survey and West Virginia University.

Pharkidonotus percarinatus var. tricarinatus (Shumard)

Bellerophon percarinatus. Norwood and Pratten, 1855, Acad. Nat. Sci., Philadelphia Jour., 2d ser., vol. iii, p. 74, pl. ix, figs. 4a-c.

Coal Measures: Grayville, Illinois; Posey county, Indiana, and 5 miles below New Harmony.

Description.—From the preceding species this variety differs in having the strong, angular, transverse plications with nodes developed on each side of the median keel. This is a very variable feature and differs even on young and old portions of the:

same shell. The variety is the more common of the two. Young shells are apt not to have the side nodes developed strongly.

The foregoing *Bellerophontidae* are all characterized by features which are so distinct that in the mature shells there is no confusion in the identification of the species. However, young shells of these species may be very hard to separate from each other. This is especially true of *Bucanopsis perlata*, *B. kansasensis*, and *Patellostium montfortianum*, all of which have a more or less strongly reticulated surface ornamentation. Young specimens have this ornamentation less pronounced, which has the result of lessening the peculiarly emphasized features of each which give to the several species their diagnostic marks. If we consider the surface ornamentation of these shells to be composed essentially of two elements, revolving and transverse lines, we will see that in *Bucanopsis perlata* neither of these is emphasized, but both are fine, in *B. kansasensis* the transverse element is emphasized, giving raised plications, while in *Patellostium montfortianum* these last are further developed into nodes. In attempting to distinguish between the young of these species the shape and proportions are the surest criteria. The first of the three is the least globose, being somewhat compressed laterally; the second is the most globose; while the third expands much more rapidly than any of the others.

Occurrence.—CONEMAUGH SERIES, AMES LIMESTONE, throughout the county, (a); BRUSH CREEK LIMESTONE, Grant district, 0.9 mile west of Bruceton Mills; Garrett county, Maryland, Corinth Basin.

Collections.—West Virginia Geological Survey and West Virginia University.

Family Pleurotomariidae

Genus WORTHENIA de Koninck

Subgenus ORESTES Girty

Worthenia (Orestes) intertexta (Meek and Worthen)

Pleurotomaria brazoensis ? Meek and Worthen, 1866, Geol. Survey Illinois, vol. ii, p. 354, pl. xxviii, figs. 1a-d.

Lower Coal Measures: Hodge's Creek, Macoupin county, Illinois.

Pleurotomaria intertexta. Meek and Worthen, 1866, *idem.*, p. 355.

Description.—Our shells agree with the original description and present the same differences from the description by Shumard of his species *brazoensis* as noted by Meek and Worthen. It is thought that this represents without doubt a distinct species and the name suggested by Meek and Worthen on page 355 as referred to above is therefore applied to it.

Occurrence.—Conemaugh Series, AMES LIMESTONE, at all the localities from which good collections have been obtained, (c).

Collections.—West Virginia Geological Survey and West Virginia University.

Genus PHANEROTREMA Fischer

. *Phanerotrema grayvillense* (Norwood and Pratten)

Pleurotomaria grayvillense. Norwood and Pratten, 1855, *Acad. Nat. Sci.*, Philadelphia, 2d ser., vol. iii, p. 75, pl. ix, figs. 7a-b. Coal Measures: Grayville, Illinois; near mouth of Rush Creek, Posey county, Indiana; Shawneetown and Galatia, Illinois.

Occurrence.—Conemaugh Series, AMES LIMESTONE, throughout the county, (a); BRUSH CREEK LIMESTONE, Grant district, 0.9 mile west of Bruceton Mills, (c), and 0.9 mile northeast of Bruceton Mills; Garrett county, Maryland, B. & O. R. R. cut at Hutton.

Collections.—West Virginia Geological Survey and West Virginia University.

Family Euomphalidae

Genus SCHIZOSTOMA Bronn

Schizostoma catilloides (Conrad)

Inachus catilloides. Conrad, 1842, *Acad. Nat. Sci.*, Philadelphia, Jour., 1st ser., vol. viii, p. 273.
Coal Measures.

Occurrence.—Conemaugh Series, AMES LIMESTONE, throughout the county, (a); BRUSH CREEK LIMESTONE, at nearly all the localities examined, (c).

Collections.—West Virginia Geological Survey and West Virginia University.

Genus ZYGOPLEURA Koken

Zygopleura plicata (Whitfield)

Plate xliii, Fig. 29.

Loroxema plicatum. Whitfield, 1882, N. Y. Acad. Sci., Ann., vol. ii, p. 231.

Coal Measures: Carbon Hill, Hocking county, Ohio.

Loroxema plicatum. Whitfield, 1891, N. Y. Acad. Sci., Ann., vol. v, p. 601, pl. xv, figs. 14, 15.

Coal Measures: Carbon Hill, Hocking county, Ohio.

Description.—Shell small and slender, spire elevated, apical angle about fifteen degrees, whorls from eight to eleven, including the protoconch, fifteen strong vertical plications on the larger volutions; plications on the several volutions in line with those below but set enough back of it to be in line with the slope of the plications. This gives them a somewhat spiral arrangement on the shell, the whole having a twist of about one-fourth of one turn in the length of the shell. Aperture elongate and pointed below. Suture distinct. Umbilicus lacking.

We have one very beautifully preserved shell which shows on the larger volutions 20 to 25 extremely fine revolving lines which are perpendicular to the axis of the shell and not parallel to the suture, crossing these are less regular and usually fainter lines of growth.

Length of a specimen with ten volutions, 10 mm.; thickness of last volution, 4 mm.

This species and others of the same type have long been referred by various authors to the genus *Loroxema* which has a surface smooth but for S-shaped growth lines. *Zygopleura* is like the latter, but has on the volutions transverse, slightly curved ribs, or transverse nodose keel, as was pointed out to the writer

by Dr. G. H. Girty, who has discussed this genus in a publication on the Wewoka Fauna of Oklahoma, at the present writing in press for the U. S. Geological Survey.

Occurrence.—Conemaugh Series, AMES LIMESTONE, Portland district, 0.6 mile east of Trowbridge, (c) ; Reno district, 0.5 mile northwest of Feilowsville; BRUSH CREEK LIMESTONE, Valley district, 2.1 miles east of Reedsville; Grant district, 0.9 mile west of Bruceton Mills, (?)

Collections.—West Virginia Geological Survey and West Virginia University.

Zygopleura sp.

Plate xliii, Fig. 30.

Description.—Like *Z. plicata* in outline, but larger and with the plications more numerous and more flattened. Volutions 14 in number, with 20 or 21 plications on the larger volutions; plications almost straight in outline and not convex as in *Z. plicata*, suture, hence, not so conspicuous as in that species. Some specimens of the last named which are worn do not show the convexity of the plications which unworn specimens exhibit. As the specimen under description is also somewhat worn its convexity may have been reduced slightly, but even when allowance is made for this it is apparent that it was a form with less convex plicae than that species. As we have not at hand specimens nor illustrations of a number of Pennsylvanian *Zygopleurac*, no name is here given to this species, as it may prove to belong to one already published.

Occurrence.—Conemaugh Series, AMES LIMESTONE, Kingwood district, 0.9 mile northeast of M. & K. R. R. depot at Kingwood.

Collection.—West Virginia Geological Survey.

Genus SPHAERODOMA Keyes

The species here doubtfully referred to *Sphaerodoma* might with almost equal propriety be classed as of the genus *Soleniscus*, so far as we are aware. These genera should be thoroughly re-

vised from a comparison of a large number of specimens. Until such a revision is made we feel uncertain as to just what their proper generic position is.

Sphaerodoma ? *brevis* (White)

Soleniscus brevis. White, 1881, U. S. Geol. Survey W. 100th Merid., vol. iii, Supp., Append., p. xxviii, pl. iv, figs. 5a-c.

Carboniferous: Coyote Creek; north of Black Lake, and near Taos, New Mexico.

Description.—"Shell subglobose, spire short, its length being less than one-third the full length of the shell, pointed, its sides slightly concave; volutions six or seven, those of the spire small and slightly convex, the last one ventricose; suture distinct but not deep; test moderately thick; fold of the columella strong, placed somewhat nearer to the proximal than to the distal end of the aperture, and having, especially in the case of old examples, a distinct, rather broad and deep concavity or revolving furrow in the columella immediately at the distal end of the fold; callus of the inner lip upon the space behind the fold and furrow moderately thick and broad. Surface smooth or marked only by faint lines of growth.

"Length, 17 millimeters; diameter of the last volution, 11 millimeters." White, 1881.

Distinguished from the following species by its sub-globose shape, short, pointed spire and the concave outline of same.

Occurrence.—Conemaugh Series, AMES LIMESTONE, Portland district, 0.6 mile east of Trowbridge; Lyon district, 1.1 miles north of Newburg, (?); Reno district, 0.5 mile northwest of Fellowsville.

Collections.—West Virginia Geological Survey and West Virginia University.

Sphaerodoma ? *primigenia* (Conrad)

Stylifer primigenia. Conrad, 1835, Geol. Soc. Pennsylvania, Trans., vol. i, pt. ii, p. 267, pl. xii, fig. 2.

Description.—From the preceding species this differs in having a higher and thicker spire, which is straight in outline and

not concave. The angle of the apex is about 100 degrees in the two uncrushed specimens in our collection.

Occurrence.—Conemaugh Series, AMES LIMESTONE, Portland district, 0.6 mile east of Trowbridge, (c).

Collection.—West Virginia Geological Survey.

Sphaerodoma ? *primigenia* var. *intermedia*, var. nov.

Plate xliii, Figs. 24, 25, 26, 27, 28.

Description.—This variety differs from typical *primigenia* in having the spire more pointed, and hence the apical angle more acute than in that species, and the last, or body volution, less globose. Apical angle, measured from four specimens, varies from 60 to 80 degrees, which is not too great a variation, inasmuch as most of the specimens present varying apical angles as seen from different sides, this feature being due probably to pressure, the effects of which are in this region seldom entirely absent from fossils found in a shale matrix. Body volution about two-thirds the length of the shell; aperture higher than wide, and greater than half the length of the shell. One fold visible upon the columella.

This variety is intermediate in form between *S.* ? *primigenia* and *S.* ? *ventricosa*, hence the varietal name.

Occurrence.—Conemaugh Series, AMES LIMESTONE, Portland district, 0.6 mile east of Trowbridge, (c).

Collection.—West Virginia Geological Survey.

Sphaerodoma ? *ventricosa* (Hall)

Macrocheilus ventricosus. Hall, 1858, Geol. Survey Ohio, vol. i, pt. ii, p. 718, pl. xxix, fig. 8, (not *Phasianella ventricosa* Goldfuss, 1841).

Lower Coal Measures: Des Moines Valley, Iowa.

Description.—¹⁹This species may be distinguished from the

19. This variety was described under the name here given in a manuscript submitted by the author to the Johns Hopkins University, describing the "Invertebrate Fauna of the Pennsylvanian of Maryland," which was the result of work done for the Maryland Geological Survey.

preceding by its higher spire, greater number of volutions, and more elongated body volution, which is, with the exception of the variety of *S. ? primigenia* here called *intermedia*, somewhat less globose than either of the species of this genus described above; it is possibly a shade less globose than *intermedia*, but the difference is small.

Occurrence.—Conemaugh Series, AMES LIMESTONE, Kingwood district, 0.9 mile northeast of M. & K. R. R. depot at Kingwood; Portland district, 0.6 mile east of Trowbridge; Reno district, 0.5 mile northwest of Fellowsville.

Collections.—West Virginia Geological Survey and West Virginia University.

Sphaerodoma ? fusiformis (Hall) ?

Macrochilus fusiformis. Hall, 1855, Geol. Survey Iowa, vol. i, pt. ii, p. 718, pl. xxix, fig. 7.

Coal Measures: Alpine Dam, Iowa.

Description.—A portion of a cast of the exterior of an elongated spiral shell of large size, and having preserved parts of six rounded volutions, appears to be related to this species.

Occurrence.—Conemaugh Series, BRUSH CREEK LIMESTONE, Valley district, 2.1 miles east of Reedsville.

Collection.—West Virginia Geological Survey.

Sphaerodoma ? sp. indet.

Description.—Under this head are grouped several different things, none of which is well enough preserved to be identified.

A large ventricose volution measuring 28 mm. in height and about the same in thickness with a polished surface showing fine lines of growth represents, probably, none of the species described above and a fragment of another shell from a different locality in the same horizon as the first may be the same species. It shows about the same size as that shell, and has a small pointed spire of about three volutions, presenting a convex outline. Both from the Ames limestone.

A cast of a tiny shell with the proportions of *S. ventricosa* in a length of 4.75 mm. and with four or five volutions is probably a young individual of that or some of the allied species. It is from the Brush Creek limestone.

An internal cast of a shell of apparently the shape of *S. brevis* was found in the Brush Creek limestone at Hutton, Garrett county, Maryland.

Collection.—West Virginia Geological Survey.

Genus BULIMORPHA Whitfield.

Bulimorpha nitidula (Meek and Worthen)

Loxonema nitidula. Meek and Worthen, 1860, Acad. Nat. Sci., Philadelphia, Proc., p. 465.

Upper Coal Measures: Springfield, Illinois.

Loxonema nitidula. Meek and Worthen, 1866, Geol. Survey Illinois, vol. ii, p. 374, pl. xxi, figs. 9a-b.

Upper Coal Measures: Springfield, Illinois.

Occurrence.—CONEMAUGH SERIES, BRUSH CREEK LIMESTONE, Grant district, 0.9 mile west of Bruceton Mills, 1.1 miles west of Clifton Mills, 2.1 miles north of Hopewell Church, (c), and 0.9 mile northeast of Bruceton Mills, (a).

Collections.—West Virginia Geological Survey and West Virginia University.

Family Epitoniidae

Genus ACLISINA de Koninck

Aclisina stevensiana (Meek and Worthen)

Turritella ? Stevensiana. Meek and Worthen, 1866, Geol. Survey Illinois, vol. ii, p. 382, pl. xxvii, figs. 8, 8a.

Upper Coal Measures: North branch Saline creek, Gallatin county, Illinois.

Occurrence.—CONEMAUGH SERIES, BRUSH CREEK LIMESTONE, Garrett county, Maryland, B. & O. R. R. cut at Hutton, (c).

Collection.—West Virginia Geological Survey.

CEPHALOPODA

Family Orthoceratidae.

Genus ORTHOCERAS Breyn

Orthoceras colletti Miller

Orthoceras colletti. Miller, 1892, Advance Sheets, Geol. Survey Indiana, 18th Rept., p. 67, pl. x, fig. 1.

Upper Coal Measures: Kansas City, Missouri.

Occurrence.—Conemaugh Series, PINE CREEK LIMESTONE, Grant district, 0.8 mile south of Brandonville; BRUSH CREEK LIMESTONE, Grant district, 0.9 mile west of Bruceton Mills, (a); Valley district, 2.1 miles east of Reedsville, (c).

Collections.—West Virginia Geological Survey and West Virginia University.

Orthoceras sp. indet.

Description.—Fragments of two small species of this genus are too poor to be identified. One is a strongly septate form, otherwise resembling *Pseudorthoceras knoxense* in outward appearance. The other is a flattened shell on which the septae are distinctly shown and have about the proportions of those of the last named species, but they appear distinctly S-shaped; two longitudinal ridges running the length of the shell are probably due to crushing, but are quite regular, and it is possible that it represents a form related to *O. colletti*. It is much smaller than that species, and the septae are separated by one-sixth the breadth of the flattened shell.

Occurrence.—Conemaugh Series, AMES LIMESTONE, Reno district, 0.5 mile northwest of Fellowsville (first described specimen); BRUSH CREEK LIMESTONE, Garrett county, Maryland, 4 miles northwest of Oakland (last specimen described above).

Collection.—West Virginia Geological Survey.

Genus PSEUDORTHOCERAS Girty

Pseudorthoceras knoxense (McChesney)

Orthoceras knoxensis. McChesney, 1860, Desc. New Pal. Foss., p. 69.

Coal Measures: Danville, Springfield, Peoria, and Dr. E. Hall's mill, Knox county, Missouri.

Description.—Among the cones referred to this species are numerous casts which show the interior of the shell and its structure nicely. The shell and secondary calcareous deposits around the walls have been leached out, leaving a filling of shaly matter in the place of the siphuncle and the open portion of the chambers. A specimen of the unleached shell was cut and polished and shows the characters of Girty's genus.

Occurrence.—Conemaugh Series, AMES LIMESTONE, throughout the county; BRUSH CREEK LIMESTONE, Grant district, 0.9 mile west of Bruceton Mills, and 0.9 mile northeast of Bruceton Mills; Valley district, 2.1 miles east of Reedsville, (c).

Collections.—West Virginia Geological Survey and West Virginia University.

Family Tainoceratidae

Genus TAINOCERAS Hyatt

Tainoceras occidentale (Swallow)

Nautilus occidentalis. Swallow, 1858, St. Louis Acad. Sci., Trans., vol. i, p. 196.

Permian: Valley of Cottonwood, Kansas.

Nautilus quadrangulus. McChesney, 1865, Ill. New Spec. Foss., pl. iii, figs. 5a, b.

Occurrence.—Conemaugh Series, AMES LIMESTONE, throughout the county; BRUSH CREEK LIMESTONE, Grant district, 0.9 mile west of Bruceton Mills, (?); Valley district, 2.1 miles east of Reedsville, (c); Garrett county, Maryland, 4 miles northwest of Oakland, (?)

Collections.—West Virginia Geological Survey and West Virginia University.

Nautilloidea indet.

Description.—Two species are represented by some poorly preserved material of this order which we have at hand. One of these is a small coiled shell, with a row of proportionally large and smoothly rounded nodes on the outer angle of the lateral surface.

The other species is a medium sized, discoidal, enrolled shell, showing no lines of growth, or other surface ornamentation, except what is apparently a ridged keel on the dorsum. I am not sure that this may not be a feature of crushing.

Occurrence.—Conemaugh Series, AMES LIMESTONE, Lyon district, 1.1 miles north of Newburg (the second form described); BRUSH CREEK LIMESTONE, Garrett county, Maryland, 4 miles northwest of Oakland.

Collection.—West Virginia Geological Survey.

ARTHROPODA

CRUSTACEA

Family Proctidae

Genus GRIFFITHIDES Portlock

Griffithides sangamonensis (Meek and Worthen)

Phillipsia (*Griffithides*?) *Sangamonensis*. Meek and Worthen, 1865, Acad. Nat. Sci., Philadelphia, Proc., p. 271.

Upper Coal Measures: Springfield, Illinois.

Phillipsia (*Griffithides*?) *Sangamonensis*. Meek and Worthen, 1873, Geol. Survey Illinois, vol. v. p. 615, pl. xxxii, fig. 4.

Upper Coal Measures: Springfield, Illinois.

Description.—Our shells consist of characteristic pygidia, glabellae, and one specimen of a cheek and spine.

Occurrence.—Conemaugh Series, BRUSH CREEK LIMESTONE, Grant district, 0.9 mile west of Bruceton Mills, (a); 1.2 miles southeast of Brandonville, (a), and 0.9 mile northeast of Bruceton Mills, (c).

Collections.—West Virginia Geological Survey and West Virginia University.

Trilobita incerta

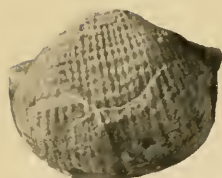
Description.—An elongate, oval, slightly crescentic eye of a trilobite, limited on all sides by a narrow, rounded furrow, which is produced at one end to form a pointed spine, was found associated with abundant specimens of *Griffithides sangamonensis* at one locality. Unlike eyes of that species, which are smooth, it is covered with very numerous, minute, hexagonal facets, arranged regularly in lines crossing the eye obliquely and transversely. 13 facets were counted in a length of one millimeter; the eye is 4 mm. long by 1 mm. broad; calculating roughly by these measurements, we estimate about 600 facets. The specimen is a cast of the interior surface of the eye. If these represent true external facets, which it is to be supposed that they do, this is a representative of the family *Phacopidae*, which is said in the second edition of Eastman's translation of von Zittel's "Text-Book of Paleontology" to become extinct in the Devonian. Until more material is at hand, no definite conclusion as to the relationship of this form is warranted.

Occurrence.—Conemaugh Series, BRUSH CREEK LIMESTONE, Grant district, 0.9 mile west of Bruceton Mills.

Collection.—West Virginia Geological Survey.

PLATE XLII.

	Page.
Figs. 1 and 2. <i>Productus semireticulatus</i> Martin.....	495
1. Pedicle valve, somewhat exfoliated.....x 1.	
2. Brachial valve, cast of exterior.....x 1.	
Pine Creek Limestone, Grant district, 0.7 mile south of Laurel Church.	
Figs. 3 and 4. <i>Productus insinuatus</i> Girty.....	497
3. Pedicle valve, beaks and lateral margins not entire..x 1.	
4. Profile of same.....x 1	
Pine Creek Limestone, Grant district, 0.8 mile south of Brandonville.	
Fig. 5. <i>Productus pertenuis</i> Meek.....	498
Pedicle valve.....x 1.	
Ames Limestone, Reno district, 0.5 mile northwest of Fellowsville.	
Fig. 6. <i>Spirifer cameratus</i> Morton.....	500
Cast of interior of pedicle valve.....x 1.	
Pine Creek Limestone, Grant district, 0.8 mile south of Brandonville.	
Figs. 7 to 16. <i>Composita subtilita</i> (Hall).....	501
7-10. Pedicle valves, casts of interior, showing variation in the muscle markings.....x 1.	
11-16. Brachial valves, casts of interior, showing varia- tion x 1.	
Figs. 8, 9, 10, 12, 13 and 16 from Brush Creek Lime- stone, Valley district, 2.1 miles east of Reedsville; Figs. 7 and 15 from Brush Creek Limestone, Grant district, 0.8 mile south of Brandonville; Figs. 11 and 14 from Brush Creek Limestone, Grant district, 0.9 mile west of Bruceeton Mills.	
Figs 17 to 21. <i>Ambococlia planiconvexa</i> (Shumard).....	501
17. Pedicle valve, dorsal view.....x 1.	
18. Brachial valve, exterior, lower margin distorted.....x 1.	
19. Pedicle valve, ventral view of beak.....x 3.	
20. Lateral view of same specimen.....x 3.	
21. Pedicle valve, cast of interior.....x 3.	
Ames Limestone; Fig. 17 and 18, Lyon district, 1.1 miles north of Newburg; Figs. 19 and 20, from a specimen from Reno district, 0.5 mile northwest of Fellowsville; Fig. 21, Reno district, 2.6 miles east of Fellowsville.	



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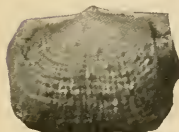
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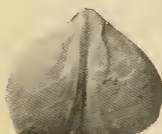
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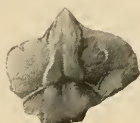
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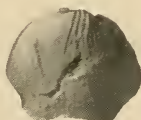
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16



17



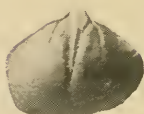
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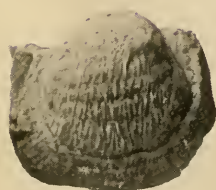
20



18



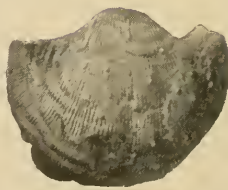
21



22



23



24

Page.

Figs. 22 and 23. *Productus nebraskensis* Owen..... 499

22. Pedicle valve, cast of interior.....x 1.

23. Brachial valve, cast of interior, showing the bifid cardinal process.....x 1.

Pine Creek Limestone, Grant district, 0.8 mile south of Brandonville.

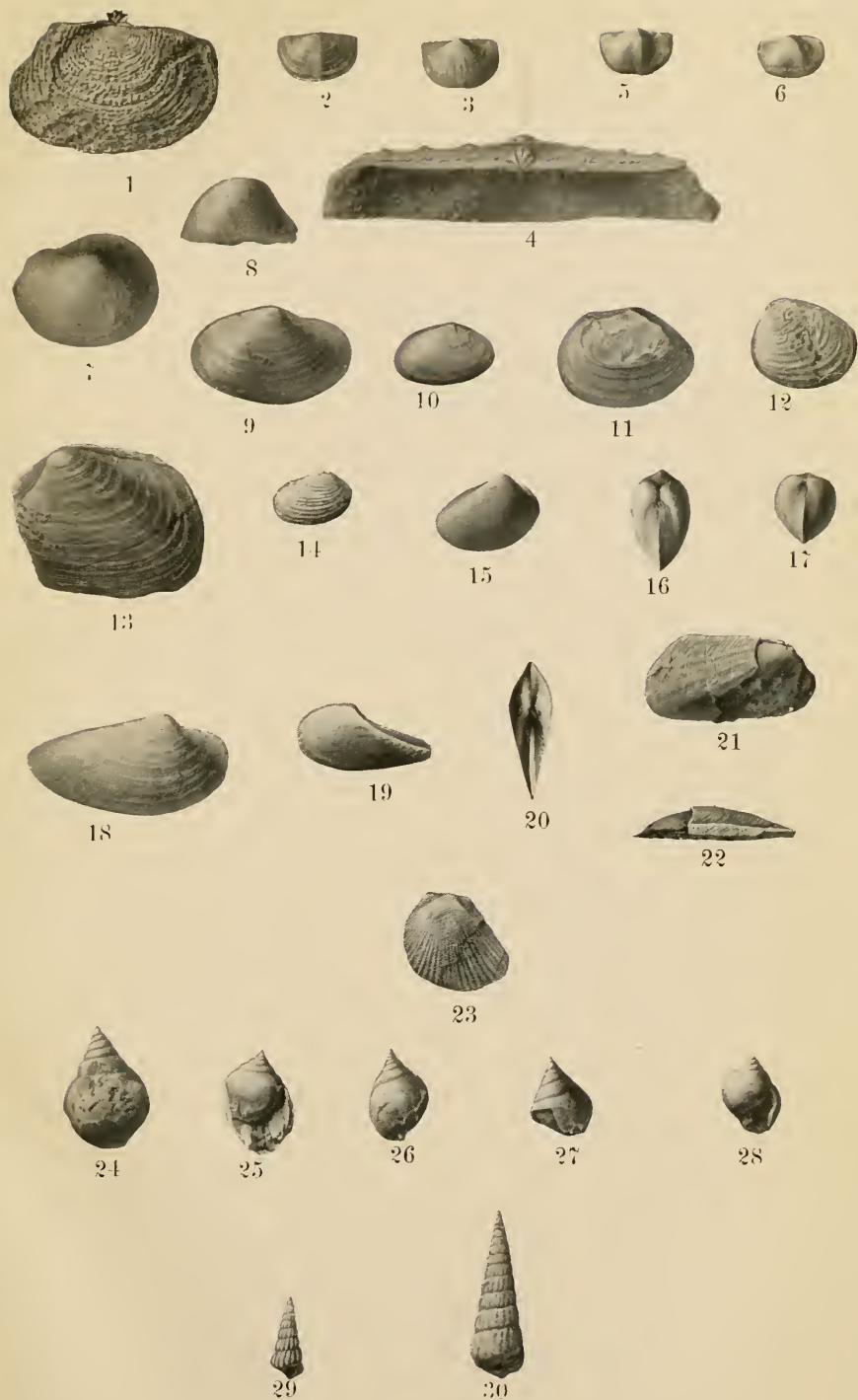
Fig. 24. *Productus cora* d'Orbigny..... 496

Pedicle valve.....x 1.

Ames Limestone, Reno district, 0.5 mile northwest of Fellowsville.

PLATE XLIII.

	Page.
Fig. 1. <i>Productus symmetricus</i> McChesney.....	499
Brachial valve, cast of exterior with impression of the trifid cardinal process above.....x 1.	
Brush Creek Limestone, Grant district, 1.2 miles southeast of Brandonville.	
Figs. 2 to 4. <i>Chonetes granulifer</i> Owen.....	493
2. Pedicle valve, dorsal view, surface somewhat exfoliated x 1.	
3. Pedicle valve, dorsal view.....x 1.	
4. Cardinal area of same.....x 5.	
Ames Limestone; Fig. 2, Portland district, east side of Cheat river, 0.6 mile east of Trowbridge, near head of ravine; Figs. 3 and 4, Reno district, 0.5 mile northwest of Fellowsville.	
Figs. 5 and 6. <i>Chonetes verneuillanus</i> Norwood and Pratten	494
Pedicle valves, somewhat exfoliated.....x 1.	
Pine Creek Limestone, Grant district, 0.7 mile south of Laurel Church, hill side, elevation 1825'.	
Figs. 7 and 8. <i>Orbiculoidea convexa</i> (Shumard).....	492
7. Brachial valve from above umbo, exfoliated.....x 1.	
8. Profile view of same.....x 1.	
Pine Creek Limestone, Grant district, 0.8 mile south of Brandonville.	
Figs. 9 and 10. <i>Edmondia ? scutum</i> , sp. nov.....	506
9. Dorsal view of the largest specimen.....x 1.	
10. Dorsal view of the smallest specimen.....x 1.	
Cotypes.	
Ames Limestone, Reno district, 2.6 miles east of Fellowsville.	
Fig. 11. <i>Edmondia ?</i> sp. 1.....	507
Dorsal view; umbo broken.	
Ames Limestone, Reno district, 2.6 miles east of Fellowsville.	
Fig. 12. <i>Edmondia aspiurcallensis</i>	509
Left valve, cast of interior.....x 1.	
Brush Creek Limestone, Grant district 0.9 mile northeast of Bruceton Mills.	
Fig. 13. <i>Edmondia ovata</i> var. <i>levis</i> , var. nov.....	510
A left valve.....x 1.	
Holotype.	
Ames Limestone, Portland district, 0.6 mile west of Trowbridge.	



R. Weber, del.

Fauna of the Conemaugh Series.

- Fig. 14. *Edmondia ovata*..... 510
 Cast of interior of a right valve.....x 1.
 Brush Creek Limestone, Grant district, 0.9 mile west of
 Bruceton Mills.
- Figs. 15-17. *Nucula anodontoides*..... 511
 15. Left valve.....x 1.
 16. Dorsal view of the two valves together.....x 1.
 17. Posterior view of the two valves together.....x 1.
 Ames Limestone, Portland district, east side of Cheat
 river, 0.6 mile east of Trowbridge, near head of ravine.
- Fig. 18. *Anthraconeoila taffiana*..... 515
 Left valve.....x 1.
 Ames Limestone, Portland district, east side of Cheat river,
 0.6 mile east of Trowbridge, near head of ravine.
- Figs. 19 and 20. *Leda meekana*..... 516
 19. Left valve.....x 2.
 20. Dorsal view of the valves together.....x 2.
 Ames Limestone, Reno district, 0.5 mile northwest of
 Fellowsville.
- Figs. 21 and 22. *Pleurophorus occidentalis*..... 528
 21. Right valve.....x 2.
 22. Dorsal view of same.....x 2.
 Conemaugh Series, Ames Limestone, Reno district, 0.5
 mile northwest of Fellowsville.
- Fig. 23. *Lima retifera*..... 526
 Right valve.....x 1.
 Ames Limestone, Reno district, 0.5 mile northwest of Fel-
 lowsville.
- Figs. 24 to 28. *Sphacrodonta ? primigenia* var. *intermedia*,
 var. nov..... 541
 Figs. 25 and 28 show the aperture and columella, which are
 somewhat broken. All natural size.
 Cotypes (the entire type material).
 Ames Limestone, Portland district, 0.6 mile east of Trow-
 bridge.
- Fig. 29. *Zygopleura plicata*.....x 1. 538
 Ames Limestone, Portland district, 0.6 mile east of Trow-
 bridge.
- Fig. 30. *Zygopleura* sp.....x 1. 539
 Ames Limestone, Kingwood district, 0.9 mile northeast of M.
 & K. R. R. depot at Kingwood.

INDEX TO SPECIES.

	Page.
<i>Acanthopecten carboniferous</i>	480, 482, 524
<i>Aclisina</i> sp.....	475
<i>Aclisina stevensiana</i>	482, 483, 543
<i>Aclisina swallowana</i>	475
<i>Allerisma terminale</i>	480, 482, 527
<i>Allerisma terminalis</i>	527
<i>Allorisma elegans</i>	529
<i>Allorisma ? leavenworthensis</i>	505
<i>Allorisma (Sedgwickia) Geinitzi</i>	529
<i>Ambocoelia planiconvexa</i>	475, 478, 480, 481, 483, 484, 501
<i>Ambocoelia planoconvexa</i>	475
<i>Anomites semireticulatus</i>	495
<i>Anthracoconeilo taffiana</i>	480, 482, 483, 515
<i>Astarte gibbosa</i>	511
<i>Astartella concentrica</i>	480, 482, 483, 530
<i>Astartella gurleyi</i>	475
<i>Astartella vera</i>	475
<i>Avicula pinnaciformis</i>	519
<i>Avicula recta-laterarea</i>	522
<i>Aviculipecten hertzeri</i>	480, 482, 522
<i>Aviculipecten pellucidus</i>	480, 482, 523
<i>Aviculipecten rectilaterarius</i>	480, 482, 483, 522
<i>Aviculipecten americana</i>	480, 482, 519
<i>Aviculopecten neglectus</i>	526
<i>Aviculopecten pellucidus</i>	523
<i>Aviculopecten</i> sp.....	475
<i>Aviculopecten (Streblopteria?) hertzeri</i>	522
<i>Aviculipectina Americana</i>	519
<i>Bellerophon crassus</i> var. <i>wewokanus</i>	480, 482, 483, 532
<i>Bellerophon Kansanensis</i>	531
<i>Bellerophon Marconianus</i>	534
<i>Bellerophon Montfortianum</i>	533
<i>Bellerophon percarinatus</i>	475, 535
<i>Bellerophon perlatus</i>	534
<i>Bellerophon stevensanus?</i>	475
<i>Bellerophon Urii</i>	533
<i>Bryozoa</i>	479, 481, 490
<i>Bucanopsis kansanensis</i>	480, 482, 483, 534 , 536
<i>Bucanopsis perlata</i>	480, 482, 483, 534 , 536
<i>Bucanopsis ? sp.</i>	480, 482, 535
<i>Bulimorpha chrysalis</i>	475
<i>Bulimorpha nitidula</i>	478, 481, 482, 543
<i>Bulimorpha ? sp.</i>	476
<i>Bulimorpha</i> sp.....	476
<i>Chaenomya leavenworthensis</i>	480, 481, 505
<i>Chonetes granulifer</i>	475, 476, 478, 479, 481, 483, 484, 493
<i>Chonetes granulifera</i>	493
<i>Chonetes variolatus</i>	476
<i>Chonetes verneuillana</i>	494
<i>Chonetes verneuillanus</i>	477, 478, 479, 481, 494
<i>Clidophorus solenoides</i>	501

	Page.
<i>Composita subtilita</i>	480, 481, 501
<i>Conch. (Helicites) pusillus</i>	489
<i>Crinoidea</i>	479, 490
<i>Crinoid fragments</i>	476, 481
<i>Deltopecten occidentalis</i>	480, 482, 525
<i>Dentalium Meekianum</i>	532
<i>Derbya crassa</i>	475, 476, 479, 481, 483, 492
<i>Discina convexa</i>	492
<i>Discina meekana</i>	491
<i>Discina missouriensis</i>	491
<i>Edmondia</i>	505-511
<i>Edmondia aspenwallensis</i>	476, 509
<i>Edmondia aspinwallensis</i>	480, 481, 509
<i>Edmondia concentrica</i>	530
<i>Edmondia gibbosa</i>	480, 482, 511
<i>Edmondia ovata</i>	480, 482, 510
<i>Edmondia ovata</i> var. <i>levis</i>	480, 482, 510
<i>Edmondia ? scutum</i> , sp. nov.....	480, 481, 506
<i>Edmondia ? sp. 1</i>	481, 507
<i>Edmondia ? sp. 2</i>	481, 508
<i>Edmondia ? sp. indet. 1</i>	481, 508
<i>Edmondia ? sp. indet. 2</i>	481, 508
<i>Endothyra ? sp.</i>	476
<i>Euchondria neglecta</i>	480, 482, 525
<i>Euomphalus catilloides</i>	476
<i>Euphemus carbonarius</i>	475, 476, 480, 482, 483, 533
<i>Griffithides sangamonensis</i>	478, 481, 482, 546
<i>Inachus catilloides</i>	537
<i>Leda attenuata</i>	476, 480
<i>Leda bellistriata ?</i>	480, 482, 483, 515
<i>Leda meekana</i>	482, 483, 516
<i>Lima retifera</i>	480, 482, 526
<i>Lingula umbonata</i>	478, 479, 481, 490
<i>Lophophyllum profundum</i>	478, 479, 481, 483
<i>Loxonema nitidula</i>	543
<i>Loxonema plicatum</i>	538
<i>Loxonema rugosum</i>	476
<i>Loxonema semicostatum</i>	476
<i>Loxonema scitulum</i>	476
<i>Machrocheilus fusiformis</i>	542
<i>Machrocheilus ventricosus</i>	541
<i>Macrodon obsoletus</i>	518
<i>Macrodon sangamonensis</i>	517
<i>Microconchus carbonarius</i>	489
<i>Myalina pernaformis</i>	520
<i>Myalina perniformis</i>	480, 482, 520
<i>Myalina</i> sp.....	480, 482, 520
<i>Nautilloidea indet.</i>	482, 546
<i>Nautilus occidentalis</i>	545
<i>Nautilus quadrangulus</i>	545
<i>Nucula anodontoides</i>	480, 482, 483, 511
<i>Nucula bellistriata</i> var. <i>attenuata</i>	516

	Page.
<i>Nucula kazanensis</i>	516
<i>Nucula parva</i>	514
.....475, 476, 480, 482, 483.	
<i>Nuculites concentrica</i>	530
<i>Orbiculoidea convexa</i>	
.....477, 479, 481,	492
<i>Orbiculoidea missouriensis</i>	
.....478, 479, 481,	491
<i>Orthis arachnoidea</i>	493
<i>Orthis umbraculum</i> ?.....	492
<i>Orthosina crassa</i>	493
<i>Orthoceras colletti</i>	481, 483, 544
<i>Orthoceras knoxensis</i>	515
<i>Orthoceras rushensis</i>	476
<i>Orthoceras</i> sp. indet.....	482, 483, 544
<i>Orthonema</i> cf. <i>subtaeniatum</i>	476
<i>Orthonema quadricarinatum</i>	476
<i>Orthonema</i> ? sp.....	476
<i>Parallelodon obsoletus</i>	
.....480, 482, 483,	518
<i>Parallelodon sangamonensis</i>	
.....480, 482,	517
<i>Patellostium montfortianum</i>	
.....475, 476, 480, 482, 483,	533, 536
<i>Pecten carboniferus</i>	524
<i>Pecten neglectus</i>	525
<i>Pecten occidentalis</i>	525
<i>Pectinoid</i> indet.....	483
<i>Pelecypod</i>	476
<i>Pelecypod</i> indet 1.....	482, 483, 531
<i>Pelecypod</i> indet. 2.....	482, 483, 531
<i>Phanerotrema grayvillense</i>	
.....480, 482, 483,	537
<i>Pharkidonotus percarinatus</i>	
.....480, 482,	535
<i>Pharkidonotus percarinatus</i> var. <i>tricarinatus</i>	480, 482, 483, 535
<i>Phillipsia (Griffithides?) Sangamon-</i> <i>ensis</i>	516
<i>Plagioglypta meekana</i>	480, 482, 532
<i>Pleurophorella geinitzi</i>	
.....480, 482, 483,	529
<i>Pleurophorus</i> cf. <i>obsoletus</i>	476
<i>Pleurophorus occidentalis</i>	
.....480, 482, 483,	523
<i>Pleurotomaria brazoensis</i>	536
<i>Pleurotomaria grayvillense</i>	537
<i>Pleurotomaria intertexta</i>	537
<i>Pleurotomaria</i> cf. <i>brazoensis</i>	476
<i>Productus aequicostatus</i>	497
<i>Productus canerini</i>	498
<i>Productus cora</i>	476, 479, 481, 496
<i>Productus cora</i> var. <i>americanus</i>	497
<i>Productus insinuatus</i>	477, 479, 481, 497
<i>Productus nebraskensis</i>	480, 481, 499
<i>Productus pertenuis</i>	479, 481, 483, 493
<i>Productus semireticulatus</i>	
.....477, 479, 481,	495

	Page.
<i>Productus symmetricus</i>	
.....478, 480, 481,	499
<i>Prothyris elegans</i>	
.....475, 480, 481, 483,	504
<i>Pseudomonotis hawii</i> ?.....	523
<i>Pseudorthoceras knoxense</i>	481, 482, 545
<i>Rhombopora lepidodendroides</i> ?...	
.....479, 481	
<i>Schizodus affinis</i> ?.....	480, 482, 521
<i>Schizodus</i> cf. <i>affinis</i>	483
<i>Schizodus</i> sp. indet.....	482, 521
<i>Schizostoma catilloides</i>	
.....481, 482, 483,	537
<i>Serpula</i> ? sp.....	476
<i>Solenmya radiata</i>	502
<i>Solenmya soleiformis</i>	503
<i>Soleniscus brevis</i>	476, 540
<i>Soleniscus paludinaeformis</i>	476
<i>Solenomya radiata</i>	475, 480, 481, 502
<i>Solenomya soleniformis</i>	480, 481, 503
<i>Solenopsis solenoides</i>	480, 481, 504
<i>Sphaerodoma</i>	539-543
<i>Sphaerodoma</i> ? <i>brevis</i>	
.....475, 481, 482,	540
<i>Sphaerodoma</i> ? <i>fusiformis</i> ?.....	
.....481, 482,	542
<i>Sphaerodoma</i> ? <i>primigenia</i>	
.....475, 476, 481, 482,	540
<i>Sphaerodoma</i> ? <i>primigenia</i> var. <i>in-</i> <i>termedia</i> var. nov.....	481, 482, 541
<i>Sphaerodoma</i> ? sp. indet.....	482, 483, 542
<i>Sphaerodoma</i> ? <i>ventricosa</i>	
.....475, 481, 482, 483,	541
<i>Spirifer cameratus</i>	
.....477, 478, 480, 481,	500
<i>Spirifer planoconvexa</i>	501
<i>Spirorbis (Microconchus) pusillus</i>	473, 476, 477, 479, 481, 489
<i>Stylifer primigenia</i>	540
<i>Tainoceras occidentalis</i>	
.....481, 482, 483,	545
<i>Tainoceras occidentalis</i> ?.....	476
<i>Terebratula permiana</i>	501
<i>Terebratula plano-sulcata</i>	502
<i>Terebratula roissyi</i>	501
<i>Terebratula subtilita</i>	502
<i>Trilobita incerta</i>	482, 547
<i>Turritella</i> ? <i>Stevensana</i>	543
<i>Vermes</i> indet.....	479, 481, 488
<i>Worthenia (Orestes) intertexta</i> ...	
.....475, 480, 482,	536
<i>Worthenia</i> cf. <i>speciosa</i>	476
<i>Zygopleura plicata</i>	481, 482, 538
<i>Zygopleura</i> sp.....	481, 482, 539

INDEX.

A		Page
A—A' Cross Section.....		72
Abbreviations, Coal Test Table.....		213
Abbreviations, Oil Test Table.....		199
Acreeage of Coal Available:		
Bakerstown Coal.....		268
Clarion Coal.....		357
Elk Lick Coal.....		266
Harlem Coal.....		266
Lower Freeport Coal.....		312
Lower Kittanning Coal.....		348
Pittsburgh Coal.....		265
Quakertown Coal.....		358
Upper Freeport Coal.....		311
Upper Kittanning Coal.....		324
Acreage of Farms.....		438
Acreage of Principal Crops.....		436
Agriculture.....		432-439
Albright Limestone.....		140
Albright Limestone, Fossils in.....		476
Albright Section.....		92
Alpha Portland Cement Co.....		385-8
Alpine Mills, description.....		38-9
Allegheny Series.....		151-176
Formations of.....		153-176
General Account and Section.....		151-2
Iron Ore.....		407-8
Local Sections.....		153
Minable Coals.....		268-357
Oil and Gas Horizons.....		197
Allen, Henry, mine 13.....		271, 364, 368
Alluvial Clay.....		372
Amblersburg, C—C', Cross Section.....		72-3
Amblersburg Section.....		96
Ames Limestone, Fossils in.....		471
Ames Limestones and Shale.....		125-8
Ames Shale, Fossils.....		127
Analyses:		
Bakerstown Coal.....		135, 364
Bolivar Fire Clay.....		155
Catskill Shale.....		190
Clarion Coal.....		367
Coal, Table of.....		364-7
Elk Lick Coal.....		364
Fire Clay.....		373-8
Harlem Coal.....		364
Iron Ore.....		408, 409, 411-12
Limestone.....		379-381
Lower Freeport Coal.....		164, 366
Lower Freeport Limestone.....		167
Lower Kittanning Coal.....		241, 366-7
Lower Kittanning Coal and Coke.....		337-9
Mineral Waters.....		419-421
Pittsburgh Coal.....		364
Quakertown Coal.....		367
Sandstone.....		393, 401-5
Shale.....		373
Sharon Coal.....		367
Soils.....		446, 448, 451, 453, 457, 461, 466
Upper Freeport Coal and Coke.....		297, 310, 364-6
Upper Freeport Limestone.....		157-9
Upper Kittanning Coal.....		366
Anticline, Definition of.....		55
Anticlines, Description of.....		60-66
Anticlines, List of.....		60
Anticlines, Minor.....		65-6
Area by Districts.....		31
Area of Different Soils.....		443
Area of Drainage Basins.....		50
Areas Suitable for Reforestation.....		424
Arnold Run Mine 80.....		347
Arnold's Ridge Monument.....		10, 19
Ashburn, Amos No. 1 (43) Core Test.....		220, 233
Ashburn Mine.....		131
Ashburn No. 16 (44) Core Test.....		220, 234
Ashby's Hill Monument.....		13, 20
Ashler, William, Mine 81.....		345, 367, 370
Astronomical Observations, Md.-W. Va. Boundary Survey.....		6
Atlantic Coal Co, Mine 54.....		304, 366, 369
Aurora & Terra Alta Turnpike.....		31
Austen Coal & Coke Co., Coke Analyses.....		310
Austen Coal & Coke Co. Core Tests:		
No. 1 (70).....		221, 243
No. 2 (71).....		221
No. 3 (72).....		221, 244
No. 4 (88).....		221, 257
No. 5 (73).....		221, 244
Austen Coal & Coke Co. Mines:		
No. 1 (48).....		297, 365, 369
No. 2 (47).....		296, 365, 369
Production.....		218
Austen Coal & Coke Co., Records.....		221, 243, 244, 257
Austen Section.....		115
Available Clay.....		371-8
Available Coal.....		See Acreage
Available Iron Ore.....		407
Available Limestone.....		383
Available Sand (Glass).....		403-5
Available Water Power.....		413
Average Percentages for Brick.....		378
Axis of Fold, definition.....		55
B		
Bailey, Lloyd.....		296
Bakerstown Coal.....		133-9, 266-8, 360, 364
Baltimore & Ohio R. R.....		26-27
Baltimore & Ohio R. R. Cut Mine.....		294
Baltimore & Ohio R. R. Levels.....		470
Barclay, S. R., Core Test 5.....		220
Base of Monuments, Md.-W. Va. Boundary.....		7
Basins, Drainage.....		49-52
Bassler, Dr. R. S.....		472
Bayard Sand.....		199
B—B' Cross Section.....		72
Beachy, Jacob, Lime Kiln.....		385
Beatty, H. C., Mine 75.....		343, 367, 370
Beatty, Thos. No. 1 (102B) Well.....		200, 215
Beaverhole Section.....		86
Beede, Dr. J. W.....		126, 475
Benson, A. L., Mine.....		275
Benson, T. E., Lime Kiln.....		140
Benson, T. E., Mine.....		145
Benson, T. S., Mine.....		133
Berea Sand.....		183
Big Injun Sand.....		188
Big Lime.....		186-7, 197
Big Sandy Creek, description.....		51

	Page		Page
Big Sandy Creek, Indicated H.P.	416	Camp Rocks Monument	14
Birmingham Shale	124	Carboniferous, Upper and Lower, Rocks	76
Birtcher, James, Mine 83	349, 367, 370	Carll, Prof. John F.	89, 208
Birtcher, L., Limestone	156-7	Carroll, Alfred (Rebecca) No. 14	
Birtcher, L., Mine 16	273, 364, 368	Core Test (75)	221, 250
Bishop, Raymond, Lime Kiln	141	Carroll, Alpheus, SS. quarry	392
Bishop, Raymond, Mine	134	Catskill Series	189-191
Bishop, Raymond, Mine 17	279, 364, 368	General Account	189
Bishop, Sarah, No. 5 (30) Core Test		Local Features	189-190
	220, 225	Oil and Gas Horizons	197
Blackwater River, Indicated H.P.	416	Red Shale	372
Bolivar Fire Clay	154-5, 374	Cattle	432
Bolyard, W. A., Mine	147	C—C' Cross Section	72-3
Bonnefield & Orr, Mine	339	Cement Mills	385-8
Borgman Coal Co., Mine 40		Census Figures	32
	301, 365, 369	Cheat River	25-6
Borgman Coal Co., Production	218	Cheat River, Core Test 15	220
Borgman, F. W.	302	Cheat River, Description	50-1
Boundary Dispute, Md. vs. W. Va.	1-24	Cheat River Gorge, Limestone Analyses	381-3
Brady, A. P.		Cheat River, Indicated H.P.	415
	295, 296, 297, 301, 303, 306, 344	Cheat River, Tributaries, Indicated H.P.	416
Brandonville & Fishing Creek Turnpike	29-30	Chemung Series	191-5
Brandonville, description	41	Chemung Series, General Account	191
Brandonville, population	32	Chemung Series, Local Features	192
Brandonville Section	80-81	Chemung Series, Oil and Gas Horizons	197
Breneman, Prof. A. A.	419	Chestnut Ridge Anticline	60-1
Bretz Mine 32	289, 365, 368	Chidester, C. S., Mine	137
Brick for Road Pavement	390	Clarion Coal	175-6, 348-357, 360
Briery Mountain Anticline (Axis)	62-64	Clarion Fire Clay	176
Brooks, A. B.	422, 424	Clarion Sandstone	175, 401-2
Brown, Elihu, Core Test 55	220	Clark, Dr. W. B.	472
Brown, Edward, Mine	135	Clarksburg Coal, Little	119
Brown, G. S.	385	Clarksburg Fire Clay Shale	119
Brown, James A., Mines	331, 341	Clarksburg Limestone	119
Brown, W. G., No. 10 Core Test (74C)	221, 247	Clarksburg Red Shale	119
Brown, W. G., No. 11 Core Test (74D)	221, 248	Clarkson, F. M.	211
Brown, W. G., No. 12 Core Test (74B)	221, 246, 321	Classification of Rocks	75-6
Brown, W. G., (74H) and (79) Core Tests	221	Clay	371-8
Brown, W. G., Mine 2	110, 364, 368	Clay, Henry, Furnace, Iron Ore	411
Brown, Wm. G., Jr., Mine 5		Clays, Limestone and Road Material	371-390
	130, 364, 368	Clifton Mills Section	82
Brown, Wm., Heirs, Core Test 60	221	Climate	429-431
Brown, W. McCulloh	1	Climatological Data	425-8
Browning Monument	14, 20	Clingerman, W. H.	338
Browning, Wm., Core Test 87	221	Clinker Fire Grinding Room	387
Browns Mill Section	115	Coal Analyses, Table of	364-7
Bruceton, Description	41-2	Coal, Chapter XII	216-370
Bruceton, Population	32	Coal House (Cement Plant)	387
Brush Creek Coal	144	Coals, Movable	260-363
Brush Creek Limestone, Fossils in	177	Allegheny Series	268-357
Brush Creek Limestone & Shale	142	By Magisterial Districts (Page References)	360-3
Brydon, L. B., Mine 62	319, 366, 369	Conemaugh Series	265-8
Brydon, L. B., Mine 66	332, 366, 369	Monongahela Series	263-5
Brydon, L. B., Mine 68	333, 367, 370	Mississippian and Devonian, Absence of	358
Buckhorn Portland Cement Co.	385	Pottsville Series	358
Bucklew, J. C., Mines	126, 129, 294	Coal Production, 1888-1912	215
Buffalo Sandstone	142-3	Coal Production, by Mines	218
Buhrstone Iron Ore	409-10	Coal Production, Order of Counties	217
Building Stone	391-400	Coals, Relative Position of	262
Burchinal Monument	14, 21	Coal Tests, Detailed Records (See Core Tests)	222-261
Burk No. 1 Mine (36)	291, 365, 369	Coal Tests, Summarized Records	220-2
Burk No. 2 Mine (34)	290, 365, 369	Coke Analyses, Upper Freeport	319
Burk No. 3 Mine (35)	291, 365, 369	Coke Production, 1912, by Mines	218
Burk No. 4 Mine (33)	290, 365, 369	Coke Tests, H. C. Frick Coke Co.	
Butterfield, Mr.	200, 211	Wolf Mine	336-7
C			
Caddell Lumber Co. Mine	298	Colebank, Daniel, Mine	306
Cale, Harrison, Mine 18	279, 364, 368	Colebank Syncline	71
Callahan, J. M.	413	Collier, Lucinda, Core Test 59	220
Campbell, M. R.	30	Collins, James, No. 1 Well (3)	200, 202

	Page.
Compression Tests, Sandstone.....	397
Conemaugh Series.....	112-150
Description of Formations.....	117-150
Fossils in.....	See Fossils
General Account.....	112-3
General Sections.....	113, 473-4
Iron Ores.....	407
Local Sections.....	114-7
Miutable Coals.....	265-8
Oil and Gas Horizons.....	197
Conley, Dolph J., Mine.....	286
Conn, Isaac.....	302, 303
Connellsville Sandstone.....	118
Connellsville Sandstone, Lower.....	119
Contours, Structure.....	56-9
Cool, Thos., Heirs, Mine.....	335
Core Tests by Numbers:	
4, 5, 5A.....	220
6.....	80, 220
7.....	80-1, 220
8, 9, 10, 11, 12, 13, 14, 15.....	220
16.....	78, 220
17.....	220, 222
18, 19.....	220, 223
21, 22, 23, 24, 25, 26, 27.....	220
27A, 28.....	220, 224
29, 30.....	220, 225
31.....	220, 226
32.....	220, 227
33.....	220
36.....	220, 228
37.....	220, 229
38.....	220, 230
39, 40.....	220, 231
41, 42.....	220, 232
43.....	220, 233
44, 45.....	220, 231
47.....	220, 235
48.....	220
49.....	220, 236
50, 51.....	220, 237
52, 53.....	220, 238
54, 55, 56.....	220, 239
57, 58, 59, 60.....	221, 239
61.....	221
63.....	221, 240
64.....	221
65.....	221, 242
66.....	221
68.....	90, 221
70.....	221, 243
71.....	221
72, 73.....	221, 244
73A.....	221
74.....	221, 245
74A, 74B.....	221, 246
74C.....	221, 247
74D, 74E.....	221, 248
74F, 74G.....	221, 249
74H, 74K.....	221
75.....	221, 250
75A, 76, 77, 78, 79, 80, 81.....	221
82.....	94, 221
83.....	95, 221
84.....	221, 258
85, 87.....	221
88.....	221, 257
89.....	221, 251
91.....	221, 252
92.....	221, 253
93.....	221
94.....	221, 253
95.....	221, 255
96.....	221
97A.....	221, 250
98.....	221
103, 104.....	221, 259

	Page
Coriuth Basins, Fossils in.....	482-5
Cornwall, Calvin, No. 2 Core Test (63).....	221, 240
Cove District, Barbour County, Coal Tests.....	221
Craig & Moore, Mine 4.....	121, 364, 368
Craig & Moore, Mine 9.....	137, 364, 368
Craig, J., Mine 8.....	137, 364, 368
Craig, James, Mine 10.....	137, 364, 368
Crane Heirs, Mine 79.....	345, 367, 370
Cranesville, A—A', Cross Section.....	72
Creek and River Gravel.....	389
Crinoidal Coal.....	128
Crogan, James, Mine 11.....	136, 364, 368
Croger, John, Mine 8.....	137, 364, 368
Crops.....	433
Crops, Acreage and Yield.....	436
Crop Rotation.....	437
Cross Sections.....	59
Cross Sections, A—A', B—B', C—C'.....	72
Cross Sections, D—D', E—E'.....	73
Cupp, Alfred, Core Test 22.....	220

D

Davis Coal & Coke Co.....	221, 259, 346
Davis, Joe, Mine.....	162-3
Dawson's Hill Monument.....	12, 20
D—D' Cross Section.....	73
Deacons, Frank, No. 1 Well (102).....	200
Debillier, No. 1 Well (62).....	200, 207-8
Detrick's, L., Ridge Monument.....	18, 22
Deem, J. P.....	207
Deer Park Anticline.....	64-5
Definition of Geological Terms.....	55-6
Dekalb Silt Loam.....	442, 443, 447-8, 468
Dekalb Silty Clay Loam.....	441-2, 443-6, 468
Dekalb Stony Loam.....	442-3, 449-51, 468
Dekalb Stony Silt Loam.....	442-3, 451-3, 468
Dennis, David, Mine.....	274
Description, General.....	31-42
Description, Geological Terms.....	55-6
Description of Species, Conemaugh Series.....	488-517
Detailed Records of Borings.....	222-260
Detailed Structure.....	60-74
Development of Clays, Absence of.....	371
Development of Limestone.....	379-388
Development of Water Power.....	412
Devonian Rocks.....	76, 189-195
Devonian Rocks, Absence of Coals in.....	358
Diamond Drill Borings (See Core Tests).....	219-260
Dip, definition of.....	56
Distances, Md.-W. Va. Boundary.....	5-6
Dixie Mine (46).....	296
Dorsey, G. W., Core Test 74K.....	221
Drainage Area.....	50
Drainage Basins.....	49-52
Dry Fork, Indicated H.P.....	416
Dulaney Anticline.....	40
Dunn, Thomas, Clay Mine.....	376
Dunn, Thomas, Mine.....	322

E

Eddy No. 5 Core Test (36).....	220, 228
E—E' Cross Section.....	73
Egdon Anticline.....	66
Elevations, Md.-W. Va. Boundary.....	6
Elevations, Railroad Stations.....	470-1
Elizabeth Sand.....	190
Elk Lick Coal.....	120-3, 265-6, 360

	Page
Elk Lick Limestone.....	123, 379
Elkins Coal & Coke Co.: Bakerstown Coal, Mine.....	135
Coke Analyses.....	319
Core Test No. 4 (53).....	220, 233
Core Test No. 12 (40).....	220, 231
Core Test No. 14 (41).....	220, 232
Core Test No. 14 (75A).....	221
Mine No. 2 (Bretz) (32).....	289, 365, 368
Mine No. 4 (37).....	301, 365, 369
Mine No. 6 (Masontown No. 5) (30).....	288, 365, 368
Mine No. 6 (Masontown No. 4) (31).....	289, 365, 368
Mine No. 7 (Burk No. 1) (36).....	291, 365, 369
Mine No. 7 (Burk No. 2) (34).....	290, 365, 369
Mine No. 7 (Burk No. 3) (35).....	291, 365, 369
Mine No. 7 (Burk No. 4) (33).....	290, 365, 369
Production.....	218
Records by.....	220-1, 224-229, 230-239, 245, 246, 247, 248, 249, 250
Elkins, Davis.....	135
Elliott, A. J.....	38
Elsey's Hill Monument.....	16, 21
Emerson, James, Mine.....	110
Englehart, I. M.....	43
Englehart Woolen Mill Co.....	43
Estimated Coal Tonnage.....	...
(See Quantity of Coal Available)	
Etam Anticline.....	65-6
Eureka Spring.....	420
Evansville Section, N.E.....	116
Evansville Section, South.....	116
Evansville Syncline.....	67-8
Everley Brothers Mine.....	349
Ewing Limestone.....	130

F

Fairfax No. 21 Core Test (54).....	220, 239
Fairfax Stone.....	8-9, 19
Fairfax Stone, Restored, 1910.....	9
Farms, Acreage of.....	438
Faults.....	56, 73-4
Faunal Horizons, Conemaugh Series.....	473-487
Fawcett, Allen, Mine.....	299
Fawcett No. 8 Core Test (74F).....	221, 249
Fawcett No. 15 Core Test (45).....	220, 234
Feather, Andrew, Limestone quarry.....	381-2
Feather, D. O., Core Test 78.....	221
Feather, Joseph W., Mine 60.....	317, 366, 369
Feather, Samuel, Mine.....	278
Features, Topographic.....	52-4
Fellowsville Section.....	117
Felton, E. S.....	94
Felton, Scott, Shale.....	190
Ferriferous (Vanport) Limestone.....	175
Field, H. E.....	338, 339
Fields, Earl, Mine.....	286
Fields, James, Mine.....	317
Fifth Sand.....	190
Fifty-Foot Sand.....	190
Fike, Alexander, Mine 64.....	327, 366, 369
Fike, F. T., Ridge Monument.....	18, 22
Fike, Joshua, Limestone.....	167-8
Fike, Joshua, Mine.....	162
Fike Mountain (N. & S. Brows) Monuments.....	16, 21

	Page
Fike, Silas, Ridge Monument.....	12, 20
Fine Raw Grinding Room.....	386-7
Fire Clay.....	373-8
Fitz Gerald, Nat Ward, Spring.....	420
Five Forks Anticline.....	65
Foreman, Isaac, No. 13 Core Test (74).....	221, 245
Foreman, Lewis, Mine.....	325
Forests.....	422-4
Fossils in Ames Shale.....	127
Fossils in Catskill, Absence of.....	190-1
Fossils in Conemaugh Series: Description of Species.....	488-547
Faunal Horizons.....	473-487
Albright Limestone.....	476-7
Ames Limestone.....	474-6
Brush Creek Limestone.....	477
Pine Creek Limestone.....	477
Geographical Distribution, Table of.....	481-2
Index to Species.....	552-3
Register of Localities.....	485-7
Stratigraphic Distribution, Table of.....	479-81
Fossils in Greenbrier Limestone.....	187
Fourth Sand.....	190
Frankhouser, John, Mine.....	162, 276
Frankhouser, L. E., Mine.....	275
Franklin Furnace.....	406
Frazee, A. K., No. 2 Core Test (8).....	220
Frazee, Truman, Limestone.....	161, 168
Frazee, Truman, Mine.....	275
Frazier, R. B.....	205, 215
Freeland, James A.....	341
Friend's, Hubert, Ridge Monument.....	17, 21
Friend's, Melvin, Hill Monument.....	17, 21
Friend's, Sherman, Hill Monument.....	17, 21
Friendsville Coal.....	128
Fristoe, E. T.....	420-1
Frosts, Killing, Dates of.....	431
Funk, Jonathan, Mine 71.....	340, 367, 370
Funk, John, No. 1 Well (101).....	200
Furnaces, Old Iron Ore.....	405-6

G

Gannett, Samuel S.....	1, 2, 23
Gantz Sand.....	190
Garlutz No. 9 Core Test (74E).....	221, 248
Garner, Thomas, Mine.....	299
Garrett Co., Md., Coal Tests.....	221, 259
Garrett Co., Md., Oil Tests.....	200, 212
Gas, Natural.....	196-215
Description of Sands.....	193
Horizons of W. Va.....	197
Sands, Intervals Below Pgh. and U. F. Coals.....	193
Tests, Summarized.....	200
Gawthrop, R. M.....	49
Gearheart, R. W., Clay Mine.....	376
General Description of Area.....	31-42
General Sections.....	75-105
Allegheny Series.....	152
Conemaugh Series.....	113, 179-4
Grant District.....	76-82
Kingwood District.....	92-4
Lyon District.....	88-92
Pleasant District.....	82-6
Portland District.....	94-6
Pottsville Series.....	177
Reno District.....	96-101
Summary of.....	104-5
Union District.....	161-3
Valley District.....	86-8

	Page.
Geodetic Positions, Md.-W. Va.	
Boundary.....	6
Geology, Part II.....	55-195
Geological Formations Giving Residual Soils.....	440
Gibson Heirs Mine 89.....	184, 367, 370
Gibson, Zacheus, Mine 82.....	354, 367, 370
Girty, Dr. G. H.....	472
Glad Farms Syncline.....	69-70
Glades, description of.....	53
Gladesville Furnace.....	406
Gladesville Section, 2 mi. S. E.....	88
Gladly Fork, Indicated H. P.....	416
Glass Sand.....	400-405
Glover, Clayton, Mine.....	278
Glover, D. W., Limestone.....	167-8
Glover, D. W., Mine 14.....	274, 364, 368
Gocella, C. A.....	395
Gocella Quarry.....	133, 394-5
Goff, Walter, Mine.....	305
Gordon Sand.....	190
Gorman Coal & Coke Co.:	
Mine No. 1 (52).....	306, 366, 369
Mine No. 2 (50).....	303, 366, 369
Mine No. 3 (51).....	303, 366, 369
Mine No. 4 (49).....	297, 365-6, 369
Production.....	218
Grafton, Killing Frosts at.....	431
Grafton, Precipitation.....	430
Grafton Sandstone.....	124
Grafton, Temperature.....	431
Graham, David, Mine.....	280
Graham, J. B., Mine.....	165
Graham, Joseph, Mine.....	285-6
Grant District:	
Area.....	31
Bakerstown Coal.....	133, 266-8, 361
Clarion Coal.....	348-51, 361
Coal Tests, Detailed.....	222
Coal Tests, Summarized.....	220
General Sections.....	76-82
Greenbrier Limestone.....	380-1
Lower Freeport Coal.....	361
Lower Kittanning Coal.....	324-8, 348, 361
Minable Coals.....	361
Oil Tests.....	200
Population.....	32
Prospective Oil and Gas Areas.....	202-3
Upper Freeport Coal.....	268-277, 311, 361
Upper Kittanning Coal.....	314-5, 324, 361
Well Records.....	201-2
Gravel for Road Material.....	359
Greaser, John, No. 7 Core Test (746).....	221, 249
Great Elk Oil & Gas Co.....	200, 207
Greathouse, Ezekiel, Mine.....	284
Great War Path.....	28
Greenbrier Limestone.....	186-7, 379-388
Greenbrier Limestone, Analyses.....	381
Greenville Furnace, Limestone.....	380, 405
Greenville Furnace, Ores.....	411-12
Greer, H. C.....	287
Grim, H. A., Limestone.....	280
Grim, H. A., Well No. 1 (1).....	200, 202
Grim, H. A., Well No. 2 (2).....	200, 202
Grimsley, G. P.....	385, 394, 395, 398, 402, 407
Grinding Rooms (Cement Plant).....	386-7
Groves, Ioab, Mine 25.....	282, 364, 368
Grubbe, D. J.....	301
Guffey, J. M.....	200, 208, 210, 221, 251-3, 255-6, 333
Guseman, Wm., No. 23 Core Test (51).....	220, 237
Guseman, Wm., No. 24 Core Test (50).....	220, 237

	Page.
Gustkey, C. E.....	208
Guthrie, Jeremiah, Mine.....	160, 167, 168
Guthrie, Joseph, Limestone.....	169
Guthrie, Leroy, Mine.....	346

H

Hamilton Coal Co., Core Tests 68 and 69.....	221
Hamilton Coal Co., Mine 1.....	108, 364, 368
Hamilton Coal Co., Mine 61.....	319, 366, 369
Hamilton Coal Co., Production.....	218
Hamilton Coal Co., Records.....	221
Hamilton, Jas. M., Core Test 91.....	221, 252
Hamilton, Jas. M., Core Test 92.....	221, 253
Hamilton, Jas. M., Core Test 93.....	221
Hammond Fire Clay.....	179
Hamstead Hill Monument.....	11, 19
Hanford, J. B.....	311
Hannahville Syncline.....	71-2
Hanst, Henry.....	27
Harader, Samuel.....	167
Hardesty Section.....	102
Hardesty, Thornton, Mine.....	356
Hardman Clay Mine.....	172
Hardman Fire Clay.....	172, 375-6
Harlem Coal.....	128, 131, 266, 360
Harned Heirs No. 1 Well (86).....	200, 212-4
Harshberger, Chas., Core Tests 24 and 25.....	220
Hartley, E. M., No. 3 Core Test (38).....	220, 230
Hartley, No. 6 Core Test (37).....	220, 229
Hartman, Isaiah, No. 7 Core Test (28).....	220, 224
Hartman, McClellan, Mine 22.....	281, 364, 368
Hauger, John M.....	344
Hazel-Atlas Glass Co.....	403
Heermans, Ed. M., Mine.....	135
Herring, A. F., No. 1 Core Test (12).....	220
Herring, A. F., No. 2 Core Test (10).....	220
Herring, A. F., No. 3 Core Test (9).....	220
Herring, A. F., No. 4 Core Test (11).....	220
Herring, A. F., Mine.....	276
Herring, George A.....	35
Highways.....	28-31
Hiorra Coke Co., Mine 45.....	295, 365, 369
Hiorra Coke Co., Production.....	218
Hiram Anticline.....	61
Historical and Industrial Development.....	1-43
History and Physiography.....	1-43
Hite, B. H.....	261, 363
Hite Coal & Coke Co. Mine 46.....	296, 365, 369
Hite Coal & Coke Co., Production.....	218
Hogs.....	423
Holly Silty Clay Loam.....	443, 461-3, 462
Holmes Sandstone Quarry.....	402, 404
Homewood Sandstone.....	178
Hopemont (Sanitarium).....	37-8
Hopewell Church Mine.....	299
Horchler, F. W.....	296, 297

	Page.
Horsepower of Cheat River and Tributaries.....	415-6
Horses.....	433
Horseshoe Run Syncline.....	72
Horton, A. H.....	413, 414, 417
Howe, H. C.....	425
Humberson, Frank, Mine and Limestone.....	16-2, 163
Humphreys, George L.....	295
Hunt, R. W. & Co.....	393-4
Huntington Sandy Loam.....	
.....442, 443, 463-6, 469	
Huntington Silt Loam.....	
.....442, 443, 464-5, 469	
Hydro-Electric Co. of W. Va.....	
.....77, 82, 89, 412	
Core Test No. 1 (7).....	81, 220
Core Test No. 2 (6).....	80, 220
Core Test No. 3 (16).....	78, 79, 220

I

Index of Species, Marine Fossils, Conemaugh Series.....	552
Indian Creek Coal & Coke Co.....	220
Indian Trails.....	28-29
Industries of Towns.....	34-43
Inscriptions on Monuments Md.-W. Va. Boundary.....	7
Instruments, Md.-W. Va. Boundary Survey.....	5
Intervals from Upper Freeport Coal to other Formations, Table of.....	58
Intervals from Pittsburgh & Upper Freeport Coal to Oil & Gas Sands.....	198
Iron Magnesium Spring.....	420
Iron Ore.....	405-411
Iron Spring.....	
Irona Coal Co., Mine No. 2 (39).....	
.....301, 365, 369	
Irona Coal Co., Production.....	218
Irontdale Furnace.....	406
Irving, J. H., Clay Mine.....	373-6
Irving, J. H., Sandstone Quarry.....	401
Irvinton-Late Coal Co., Mine 63.....	
.....320, 366, 369	
Irvinton-Late Coal Co., Mine 67.....	
.....332, 366, 369	
Irvinton Mineral Co.....	401

J

Jackson, Geo. B., Mine.....	292
Jackson, J. W., Mine 23.....	283, 364, 368
Jeffers, Felix T., Mine 3.....	
.....123, 364, 365	
Jefferson, Geo., Mine 56.....	163, 366, 369
Jenkins & Lyon, Mine.....	284
Jenkins, W. S., Core Test 89.....	221, 251
Jenkins, W. S., Mine.....	138
Johnstown Cement Limestone.....	171-2
Johnstown Iron Ore.....	407
Jones, S. M., Mines 72 & 73.....	
.....340, 367, 370	
Jordan, S. H., Production of Coal.....	218
Josephine Furnace.....	406

K

Kane Creek Section.....	87
Keck No. 17 Core Test (52).....	220, 238
Keener Sand.....	188
Kelley, John O., Core Test 24.....	220

Kelley Knob, Mine.....	Page. 134
Kelly, Jerome, Mine.....	330
Kendall Lumber Co., Glass Sand.....	404
Kendall Lumber Co., Mine 80.....	
.....347-8, 367, 370	
Kendall Lumber Co., Railroad.....	27
"Key"—Structure Contours.....	56-9, 198
Killing Frosts, Dates of.....	431
Kiln Room (Cement Plant).....	387
King, Evan, Limestone.....	156
King, Evan, Mine.....	316
King, M. H., Mine.....	271
King, Rev. C. H.....	420
King, Thurmond, Mine 57.....	
.....314, 366, 369	
King, T. M., Mine.....	272
Kingwood & Brandonville Turnpike.....	
.....30-1	
Kingwood & Terra Alta Turnpike.....	31
Kingwood Basin.....	68-9
Kingwood Coal Co., Production.....	218
Kingwood Coal Co., No. 1 Mine (41).....	302, 365, 369
Kingwood Coal Co., No. 2 Mine (42).....	302, 365, 369
Kingwood District:	
Area.....	31
Bakerstown Coal.....	136-7, 362
Clarion Coal.....	355-6, 362
Coal Tests, Detailed.....	245-250
Coal Tests, Summarized.....	221
Description.....	34-36
Elk Lick Coal.....	362
Harlem Coal.....	362
Lower Freeport Coal.....	362
Lower Kittanning Coal.....	341, 348, 362
Minal Coals.....	362
Pittsburgh Coal.....	265
Population.....	32
Prospective Oil & Gas Areas.....	209
Sections.....	92-94
Upper Freeport Coal.....	298-307, 311, 362
Upper Kittanning Coal.....	
.....321-2, 324, 362	
Well Records and Prospective Areas.....	209
Kingwood Manufacturing Co.....	35-36
Kingwood Mine No. 37.....	301, 365, 369
Kingwood, Population.....	32
Kingwood Quarries Co.....	391-4
Kingwood Railway Co.....	27
Kingwood Syncline (Basin).....	68-9
Kingwood Tunnel.....	40-1
Kingwood Tunnel (Tunnelton) Section.....	153
Knotts, Marcellus, Core Test 97A.....	
.....221, 256	
Knotts, William, Mine.....	109
Knowlton, & Ford Fire Clay Mine.....	374
Knowlton, J. H.....	391, 394
Knowlton Quarry.....	132, 391-4

L

Laing, John.....	216
Lanham, Cordelia A., Mine.....	129
Larew, J. H., Heirs, No. 1 Core Test (65).....	221, 242
Latimer, W. L., Soil Survey by.....	425-469
Lauer Hill (S. Brow) Monument.....	13, 20
Laurel Fork, Indicated H.P.....	416
Laurel Hill Anticline.....	60
.....321-2, 324, 362	

	Page.
Laurel Ridge Anticline.....	63
Lee, J. W., Mine.....	136
Lee, Samuel, No. 4 Core Test (32)	
.....	220, 227
Lenhart, W. L., Mine.....	308
Lesley, J. P.....	107
Levels Above Tide, Railroad.....	470-1
Light, F. M., Limestone.....	171
Ligonier Syncline.....	66-7
Limestone.....	378-388
Limestone for Road Material.....	388-9
Lindsay, James, Core Test 94.....	221
Lindsey, Jas., Mine.....	122, 253
Liston, A., No. 4 Core Test (32)...	
.....	220, 227
Liston, Benjamin, Mine.....	278
Liston, Eben, Lime Kiln.....	141
Liston, Jehu, Mine 19.....	280, 364, 368
Liston, Staley, Mine.....	163, 278
Little Clarksburg Coal.....	119
Little Lime.....	186
Little Pittsburgh Coal.....	118
Livengood, Mr.....	220
Location of County.....	1-25
Loraw, J. F., Mine 59.....	315, 366, 369
Lower Ames Limestone.....	125
Lower Carboniferous Rocks.....	76, 185-8
Lower Connellsville Sandstone.....	119
Lower Connoquenessing Sandstone.....	183
Lower Freeport Coal.....	150-165, 312, 360
Lower Freeport Limestone.....	165-169, 379
Lower Freeport Sandstone.....	169-170
Lower Kittanning Coal.....	
.....	173-4, 241, 324-348, 360
Lower Kittanning Fire Clay.....	
.....	174, 376-377
Lower Mercer Coal.....	179
Lower Mahoning Sandstone.....	147-8
Lower Pittsburgh Limestone.....	118
Lower Pittsburgh Sandstone.....	117
Lull, A. C., Mine 76.....	342, 367, 370
Lumber Industry.....	423
Lumber Railroads.....	28
Luraw, Luther, No. 6 Core Test	
(29).....	220, 225
Lynch, Thomas.....	336, 338
Lyons & Jenkins, Mine.....	284
Lyons District:	
Area.....	31
Bakerstown Coal.....	136, 362
Clarion Coal.....	354-5, 362
Coal Tests, Detailed.....	240-245
Coal Tests, Summarized.....	221
Elk Lick Coal.....	362
Harlem Coal.....	362
Lower Freeport Coal.....	362
Lower Kittanning Coal.....	
.....	331-4, 348, 362
Minal Coals.....	362
Oil Tests.....	200
Pittsburgh Coal.....	265
Population.....	32
Prospective Oil & Gas Areas.....	209
Sections.....	88-92
Upper Freeport Coal.....	
.....	292-298, 311, 362
Upper Kittanning Coal.....	
.....	318-320, 321, 362
Well Records.....	207-9
Lyons, E. A., No. 3 Core Test (64)	
.....	221

	M	Page.
Machine Shop (Cement Plant).....		387
Mackintosh, Hemphill & Co.....		338
Madison Run Section.....		101
Mahoning Coal.....		148
Mahoning Sandstone Stage.....		147-9
Man-a-eca Water Co.....		419
Manheim Cement Plant.....		385-8
Manheim Section.....		94
Manown Station Cut, Mine.....		321
Marine Fossils in Ames Shale.....		127
Marine Fossils in Catskill (Absence		
of).....		190-1
Marine Fossils in Chemung.....		194
Marine Fossils in Conemaugh Series		
..... (See Fossils)		
Marine Fossils in Greenbrier Lime-		
stone.....		187
Marquess Anticline.....		65
Martin, G. C., 64, 70, 162, 168, 186		191
Martin, George, Mine 26.....		283, 361, 368
Martin, Howard.....		134
Martin, Jackson, Mine 24.....		282, 361, 368
Martin, Newton, Mine 21.....		281, 364, 368
Maryland vs. W. Va. Boundary Dis-		
pute.....		1-24
Maryland Geological Survey.....		192, 194
Masontown, Description of.....		41
Masontown No. 4 Mine 31.....		
.....		289, 365, 368
Masontown No. 5 Mine 30.....		
.....		288, 365, 368
Masontown, Population.....		32
Material of Monuments, Md.-W. Va.		
Boundary.....		7
Matlick, C. N., Mine 12.....		139, 364, 368
Mauch Chunk Series.....		185-6, 372
Iron Ores.....		410-11
Oil & Gas Horizons.....		197
Maust, Waitman, Mine.....		273
Maximum Percentages for Brick,		
etc.....		378
Maxton Oil Sand.....		186
Mechanical Analyses of Soils.....		
.....		446, 448, 451, 453, 457, 461, 466
Medicinal Springs.....		419-422
Merchants Coal Co., Core Test 73A		
.....		221
Merchants Coal Co., Production.....		218
Merchants Coal Co., Records.....		220-1, 239
Merchants Coal Co., Tunnelton Mine		
53.....		306, 366, 369
Mersing, P. L.....		347
Metheny, Perry, No. 3 Core Test		
31.....		220, 226
Metheny, Silas, Limestone.....		157
Metheny, Silas, Mine 84.....		352, 367, 370
Metheny, Silas, Mine 87.....		181, 367, 370
Methods of Representing Structure		
.....		50-59
Michael, Jas., Heirs, Limestone.....		156
Middle Kittanning Coal.....		173
Mileage of Ordinary Co. Roads.....		31
Mill—Kingwood SS. Quarry.....		392
Miller, Benjamin, Mine.....		301
Miller, J. P. K.....		326
Miller, Thomas, Mine.....		300
Miller Monument.....		13, 20
Miller, Werlen, Limestone.....		156
Miller, William, Mine.....		286
Miller, William, Mine 58.....		
.....		314, 321, 366, 369

	Page.
Minable Coals.....	260-363
Allegheny Series.....	268-357
By Magisterial Districts (Page References).....	360-363
Conemaugh Series.....	265-268
Mississippian & Devonian, Absence of.....	358
Monongahela Series.....	263-265
Pottsville Series.....	358
Mineral Resources.....	196-423
Mineral Waters.....	418-422
Minimum Percentages for Brick, etc.....	378
Minor Anticlines.....	65-66
Minor Synclines.....	71-72
Mines, Coal, Analyses by Nos.:.....	
1 to 29.....	364
29 to 49.....	365
49 to 67.....	366
68 to 89.....	367
Mines, Coal Production by.....	218
Mines, Coal, Page References, by Nos.:.....	
1 to 32.....	368
33 to 67.....	369
68 to 89.....	370
Miscellaneous Items.....	31-4
Mississippian Rocks.....	76
Absence of Coals in.....	358
Stratigraphy.....	185-8
Monongahela Series:	
Description of Formations.....	107
General Account.....	106
Minable Coals.....	263-5
Oil & Gas Horizons.....	197
Stratigraphy.....	106-111
Monroe, Julius K.....	1, 2, 23
Monuments, Md.-W. Va. Boundary.....	
Base of.....	7-19
Inscriptions on.....	7-8
Material of.....	7
Small.....	8
No. 1.....	9, 19
Nos. 2, 3 and 4.....	10, 19
Nos. 5 and 6.....	11, 19
Nos. 7 and 8.....	11, 20
Nos. 9, 10, 11 and 12.....	12, 20
Nos. 13 and 14.....	13, 20
No. 15.....	14, 20
Nos. 16 and 17.....	14, 21
Nos. 18, 19, 20, 21 and 22.....	15, 21
Nos. 23, 24 and 25.....	16, 21
No. 26.....	17, 21
Nos. 27, 28 and 29.....	17, 22
Nos. 30, 31, 32 and 33.....	18, 22
No. 34.....	19, 22
Moore, Eli, Mine 9.....	137
Morgan, Marshall, Mine.....	308
Morgantown & Beverly Turnpike.....	30
Morgantown & Kingwood R. R.....	27
Morgantown & Kingwood R. R. Cut Mine.....	318
Morgantown & Kingwood R. R. Levels.....	471
Morgantown & Kingwood Turnpike.....	30
Morgantown, Killing Frosts at.....	431
Morgantown, Precipitation at.....	430
Morgantown Sandstone.....	120
Morgantown, Temperature at.....	431
Morris-Connell Monument.....	13, 20
Mount Carmel Syncline (Basin).....	70-1
Mount Savage Fire Clay.....	178, 377-8
Moyers, Amos, Limestone.....	169
Moyers, Amos, Mine 55.....	160, 366, 369

	Page
Moyers, Samuel, Mine.....	276
Murphy, Thomas.....	298, 303, 304, 306
Myers, A. M., Mine.....	269

Mc

McDermott, B. J.....	289, 299
McDonald Sand.....	190
McElhee, Wm.....	200
McMillen, Burgess, Mine.....	134

N

Natural Gas & Petroleum.....	196-215
Nebo Church, Section, 1 mi. S.W.....	84
Nedrow, Wm., No. 3 Core Test 31.....	220, 226
Neff, William, Mine.....	285
Newburg, Description.....	40
Newburg, Pittsburgh Coal Mine.....	109
Newburg, Population of.....	32
Newburg Section.....	89
Newburg Coal Co., Mine.....	110
Nicola, John, Core Test 13.....	220
Nicola, John, Mine.....	351
Nordeck Bros., Mine 78.....	344, 367, 370
North Preston Coal Co.....	220
Northern Trail.....	29
Northwestern Turnpike.....	29
North-West Trail.....	28
Nose, Eli & Saml. No. 1 Well 99.....	209, 210
Nose of Fold, Definition of.....	55

O

Oak Grove Church, Mine.....	299
Oakland Coal & Coke Co., Core Test 81.....	221, 258
Oakland Oil & Gas Co.....	200, 212
Offutt's Hill Monument.....	12, 20
Oil and Gas.....	196-215
Horizons of W. Va.....	197
Sands, Intervals, etc.....	198
Tests, Summarized.....	200
Wells & Prospective Areas.....	199-215
Grant District.....	201-3
Kingwood District.....	209
Lyon District.....	207-9
Pleasant District.....	203-6
Portland District.....	211-14
Reno District.....	209-11
Union District.....	214-15
Valley District.....	206-7
Old Iron Ore Furnaces.....	405-6
Oreharding.....	434-5
Order of Counties in Production of Coal.....	217
Ore, Iron.....	405-11
Origin of Soil Types.....	443
Original Timber Conditions.....	422
Orr & Bonfield Mine.....	339
Overfield No. 25 Core Test 49.....	220, 236

P

Page References to Descriptions of Coal Mines.....	368-370
Paleozoic System, Subdivisions of.....	75
Parriott, W. O.....	209
Parsons, Killing Frosts at.....	431
Parsons, Precipitation at.....	430
Parsons, Temperature at.....	431

	Page.
Peasley Bros. Well 100.....	200, 210
Petroleum & Natural Gas.....	196-215
Philadelphia Co. of W. Va.....	200, 204
Physical Tests, Sandstone.....	393-4
Physiographic Changes.....	44-9
Physiography, Chapter on.....	44-54
Pine Creek Limestone.....	110
Pine Creek Limestone, Fossils in.....	177
Pittsburgh Coal.....	107-110, 263-5, 360
Pittsburgh Coal, Interval to Oil Sands.....	193
Pittsburgh Coal, Little.....	118
Pittsburgh Limestone, Lower.....	118
Pittsburgh Limestone, Upper.....	118
Pittsburgh Red Shale.....	132, 372
Pittsburgh Sandstone, Lower.....	117
Pittsburgh Sandstone Upper.....	107
Plant Life in Chemung.....	194
Pleasant District:	
Area.....	31
Bakerstown Coal.....	134, 361
Clarion Coal.....	351-3, 361
Coal Tests, Detailed.....	222-228
Coal Tests, Summarized.....	220
Greenbrier Limestone.....	381-2
Lower Freeport Coal.....	361
Lower Kittanning Coal.....	328-9, 348, 361
Minalable Coals.....	361
Oil Tests.....	200
Population.....	32
Prospective Oil & Gas Areas.....	206
Quakertown Coal.....	361
Sections.....	82-6
Upper Freeport Coal.....	277-283, 311, 361
Upper Kittanning Coal.....	215-7, 324, 361
Well Records.....	203-6
Pocono Sandstone Series.....	187-8
Pocono Sandstone Series, Oil & Gas Horizons.....	197
Poling Monument.....	13, 20
Population, Districts & Towns.....	32-3
Population, Villages.....	43
Portage Beds, Oil & Gas Horizons.....	197
Portland District:	
Area.....	31
Bakerstown Coal.....	137, 363
Clarion Coal.....	356-7, 363
Coal Tests, Detailed.....	258
Coal Tests, Summarized.....	221
Greenbrier Limestone.....	381, 384
Harlem Coal.....	363
Lower Freeport Coal.....	363
Lower Kittanning Coal.....	342-5, 348, 363
Minalable Coals.....	363
Population.....	32
Prospective Oil & Gas Areas.....	211
Quakertown Coal.....	363
Sections.....	94-6
Upper Freeport Coal.....	307-9, 311, 363
Upper Kittanning Coal.....	322-3, 324, 363
Well Records.....	211-14
Post-Offices of County.....	34
Postal Service.....	33-4
Pottsville Series.....	177-184
Description of Formations.....	178-184
General Section.....	177
Iron Ore.....	410
Minalable Coals.....	358
Oil & Gas Horizons.....	197
Powell, S. L.....	396

	Page.
Power House (Cement Plant).....	387
Pratt, Messrs.....	123
Precipitation.....	427-430
Present Forest Conditions.....	123
Preston Anticline.....	61-2
Preston Axis.....	61
Preston Blue Stone Co. SS. Quarry	398-400
Preston Coke Co.:	
Analyses, Coke.....	310
Mine No. 1 (27).....	287, 364, 368
Mine No. 2 (28).....	288, 364, 368
Mine No. 3 (29).....	288, 364-5, 368
Production.....	218
Preston County, Formation of.....	24-25
Preston Fuel Co.....	221, 210-1, 242
Preston Fuel Co., Shaft Mine 69.....	333, 367, 370
Preston-Tucker, E. E., Cross Sec- tion.....	74
Price, W. Armstrong.....	187, 172
Production of Coal, 1888-1912.....	216
Production of Coal, by Mines.....	218
Production of Coal Order by Coun- ties.....	217
Products.....	33
Property Valuations.....	33
Prospective Oil & Gas Areas:	
Grant District.....	202
Kingwood District.....	209
Lyon District.....	209
Pleasant District.....	206
Portland District.....	214
Reno District.....	211
Union District.....	215
Valley District.....	207
Pyles, R. A., Mine.....	294

Q

Quakertown Coal.....	181, 182, 358, 360
Quantity of Coal Available:	
Bakerstown Coal.....	268, 360
Clarion Coal.....	357, 360
Elk Lick Coal.....	266, 360
Harlem Coal.....	266, 360
Lower Freeport Coal.....	312, 360
Lower Kittanning Coal.....	317-8, 360
Pittsburgh Coal.....	265, 360
Quakertown Coal.....	358, 360
Upper Freeport Coal.....	311, 360
Upper Kittanning Coal.....	323-4, 360
Quarries, Glass Sand.....	400-1
Quarries, Limestone.....	379-385
Quarry, Limestone, Alpha P. C. Co.....	386
Quarry, Sandstone, Gocella.....	391-5
Quarry, Sandstone, John F. Suer.....	395-8
Quarry, Sandstone, Kingwood.....	392-3
Quarry, Sandstone, Preston Blue Stone Co.....	398-400

R

Radabaugh, James, Mine.....	277
Radford, A., Pottery Co.....	376
Railroad Levels.....	170-1
Railroads, Lumber.....	28
Railroads, Steam.....	26-8
Rainfall.....	127-130
Rand-McNally Shippers' Guide.....	43
Rates of Absorption, Sandstone.....	397, 400
Raw Preliminary Grinding Room (Cement Plant).....	386

	Page.
Reckard Road Monument.....	16, 21
Reckart, Henry, Mine 88.....	182, 367, 370
Record of Tests for Coal, Summar- ized.....	220-1
Record of Tests for Oil, Sum- marized.....	200
Records of Borings, Detailed.....	222-260
Reed Geo.....	200, 215
Reed, Quinter & L. Sidwell, Mine.....	305
Reedsville, Description.....	41
Reedsville, Population.....	32
References (Page) to Description of Coal Mines.....	368-370
Reforestation, Areas Suitable for.....	424
Relative Position of Coal Veins.....	262
Relief.....	32
Reno District:	
Area.....	31
Bakerstown Coal.....	138-9, 362
Clarion Coal.....	355
Coal Tests, Detailed.....	251-8
Coal Tests, Summarized.....	221
Elk Lick Coal.....	362
Greenbrier Limestone.....	384
Harlem Coal.....	362
Lower Kittanning Coal.....	334-341, 348, 362
Minaable Coals.....	362
Oil Tests.....	200
Pittsburgh Coal.....	265
Population.....	32
Prospective Oil & Gas Areas.....	211
Sections.....	96-101
Upper Freeport Coal.....	304-7, 311, 362
Upper Kittanning Coal.....	320, 324, 362
Well Records.....	209-211
Rhodeheaver, Charles, Mine 85.....	352, 367, 370
Richardson, W. K., Core Test 56.....	220
Ridenour, J. W., No. 3 Core Test 74.....	221, 246
Ries, Dr. Heinrich.....	272
Rightmire, H. W.....	398
Riley, Jas. W.....	137
Ringer, Elias, Mine.....	164
Ringer, Henry, No. 8 Core Test 79	220, 224
River and Creek Gravel.....	389
River Terraces.....	54
Road Material.....	388-390
Brick for Road Pavement.....	390
Limestone.....	388
River and Creek Gravel.....	389
Sandstone.....	390
Roads, Ordinary County (Mileage).....	31
Robinson, Albert, Mine.....	275
Rockville Sections:	
North.....	77
1 Mile Northeast.....	77-9
1.5 Miles Northeast.....	85
1.5 Miles Northwest.....	84
1.8 Miles Northwest.....	79
South.....	85
2 Miles Southwest.....	82
Rogers, H. D.....	107
Rogers, No. 27 Core Test 48.....	220, 225
Rogers, W. B.....	60, 61, 62, 63, 68, 70, 380, 407, 411
Roll Room (Cement Plant).....	387
Rosier, Allie, Core Test 95.....	221, 255
Rosier Heirs, Mine.....	139
Rosier, Mary G., (Stafford), Core Test 96.....	221

	Page
Rotation of Crops.....	437
Rough Stony Land.....	442, 443, 453-4, 468
Rowe, Geo., Mine.....	182
Rowlesburg & Southern R. R.....	27-8
Rowlesburg, D—D', Cross Section.....	73
Rowlesburg, Description of.....	39
Rowlesburg, Population.....	32
Rowlesburg, Precipitation.....	427, 430
Rowlesburg Sandstone.....	194, 398-400
Rowlesburg Section.....	97-101
Rowlesburg, Snowfall.....	428
S	
Saltsburg Sandstone.....	132, 391-5
Sand, Glass.....	400-405
Sanders, George, Mine.....	355
Sand, Oil & Gas.....	197, 198
Sandstone for Road Material.....	389
Sanitarium, State Tuberculosis.....	37-8
Sanitarium, State Tuberculosis, Mine.....	182
Savage, Arthur, Mine 86.....	353, 367, 370
Scotch Hill Mine, Newburgh Coal Co. (Pgh).....	110
Scotch Hill Mine, No. 44 (U. F.).....	295, 365 369
Scotch Hill Mine, No. 70 (L. K.).....	334, 367, 370
Scott, B. C., Core Test 85.....	221
Sections:	
Albright.....	92
Amblerburg.....	96
Austen.....	115
Beaverhole.....	86
Big Sandy Creek.....	77
Brandonville.....	80
Browns Mill.....	115
Clifton Mills.....	82
Evansville, Northeast.....	116
Evansville, South.....	116
Fellowsville.....	117
Gladesville, 2 Mi. S.E.....	88
Hardesty.....	102
Kane Creek.....	87
Madison Run.....	101
Manheim.....	94
Nebo Church, 1 Mi. S.W.....	84
Newburg.....	89
Rockville, North.....	77
Rockville 1 Mi. N.E.....	77-9
Rockville, 1.5 Mi. N.E.....	85
Rockville, 1.5 Mi. N.W.....	84
Rockville, 1.8 Mi. N.W.....	79
Rockville, South.....	85
Rockville, 2 Mi. S.W.....	82
Rowlesburg.....	97
Threefork Creek.....	89
Trowbridge.....	93
Tunnelton (Kingwood) Tunnel.....	153
Sections, General.....	75-105
Allegheny Series.....	152
Conemaugh Series.....	113, 473-4
Grant District.....	76-82
Kingwood District.....	92-94
Lyon District.....	88-92, 115
Pleasant District.....	82-86
Portland District.....	94-96
Pottsville Series.....	177
Reno District.....	96-101, 115-117
Union District.....	101-103
Valley District.....	86-8, 115
Selden, David, Limestone Quarry.....	385
Seventh Sand.....	190

	Page
Severe Monument.....	11, 20
Shaffer, Cyrus, Mine.....	316
Shaffer et al.....	200
Shackelford, LeRoy, Core Test 61.....	221
Shaft Mine, 69.....	333
Shale.....	372-3
Sharon Coal.....	183-4
Sharon Conglomerate.....	184
Sharps, John, Mine.....	285
Shaw, O. Y., Mine.....	316
Shaw, Robert, Core Tests 76 & 77.....	221
Shaw, Wm. H., No. 1 Well (69).....	200, 208
.....	398
Sharing Test, Sandstone.....	432
Sheep.....	305
Sidwell, Lincoln, & O. Reed Mine.....	221
Simms, Elza, Core Test 59.....	210
Sinclair, Daniel, No. 1 Well 90.....	164
Sines Thomas, Mine.....	220
Sisler, Samuel, No. 1 Core Test 27.....	220
Sisler, Samuel, No. 2 Core Test 26.....	190
Sixth Sand.....	221
Slaney, J.....	77, 82, 89
Slocum, Dr. F. L.....	8
Small Monuments, Md.-W. Va. Boundary.....	316
Smith, J. M.....	281, 364, 368
Smith, Joseph, Mine 20.....	241
Smith, Rudy & Co., Chemists.....	330
Smith, W. H.....	277
Smith, Wilbur, Mine.....	220
Smith, Wm., Core Test 23.....	221
Smith, Wm., Core Test 57.....	308
Snake Den Bank.....	136, 146
Snider, A. J., Mine.....	130, 364, 368
Snider, Allison, Mine 6.....	427
Snow, Melted, at Rowlesburg.....	430
Snowfall, Grafton, Morgantown, Par- sons & Terra Alta.....	428
Snowfall, Rowlesburg.....	425-469
Soil Survey of County.....	439-466
Soils.....	443
Soils, Area of Different.....	28
Southern Branch Trail.....	200
South Penn Oil Co.....	192
Speckley Sand.....	271-2
Speelman, William Mine.....	327
Spiker, Joseph, Mine.....	166-7
Spindler, Chas., Mine.....	419-422
Springs, Medicinal.....	220
Spurgeon, Jesse, Core Test 14.....	188
Squaw Sand.....	10, 19
Stahlnaker Ridge Monument.....	12, 20
Stahl's Hill Monument.....	37-8
State Board of Control.....	37-8
State Tuberculosis Sanitarium.....	182
State Tuberculosis Sanitarium, Mine	26-8
Steam Railroads.....	60, 63, 108, 118, 120, 124
Stevenson, J. J.....	334
Stevenson, L. C.....	200, 202
Stewart, Jesse, et al.....	307
Stiff, Thomas.....	377
Stoer, J. E., Clay Mine.....	94-5, 221
Stoer, J. E., Core Test 2.....	95, 221
Stoer, J. E., Core Test No. 1 (83)	343
Stoer, J. E., Mine 74.....	221
Stoer, J. E., Records.....	395-8
Stoer, J. E., SS, Quarry.....	386
Stone House (Cement Plant).....	291-400
Stone Quarries.....	165
Strahan, Clyde, Mine.....	

	Page
Stratigraphy:	
Allegheny Series.....	151-176
Conemaugh Series.....	112-150
Devonian Rocks.....	189-195
General Sections.....	75-105
Mississippian Rocks.....	185-188
Monongahela Series.....	106-111
Pottsville Series.....	177-184
Stray Sand.....	190
Strawser Road Monument.....	16, 21
Stream Data, Table of.....	47-8
Strike, Definition of.....	56
Structure, Chapter on.....	55-74
Structure Contours.....	56-9
Structure, Detailed.....	60-74
Structure, Methods of Representing	56-9
Summarized Record of Tests for Coal.....	220-221
Summarized Record of Tests for Oil.....	200
Summary of General Sections.....	104-5
Summary, Soil Survey.....	466-9
Sunnyside Mine 66.....	332, 366, 369
Sunnyside Mine No. 2 (68).....	333, 367, 370
Supreme Court of U. S.—Decision, Md.-W. Va. Boundary.....	2-24
Swartz, C. K.....	194
Syncline, Definition of.....	55
Synclines, Description of.....	66-72
Synclines, List of.....	60
Synclines, Minor.....	71-2
Sypholt, W. M., Mine 38.....	309, 365, 369

T

Tables Showing:	
Acreage Adapted to Reforestation.....	424
Acreage and Yield of Principal Crops.....	436
Anticlines and Synclines.....	60
Approximate Intervals, Pittsburgh & Upper Freeport Coal to Oil & Gas Sands.....	198
Area by Districts.....	31
Area of Drainage Basins.....	50
Coal Analyses.....	363-370
Coal Production, 1888-1912.....	216
Geographical Distribution of Marine Fossils in the Cone- maugh Series.....	481-3
Geological Formations Giving Residual Soils.....	410
Greenbrier Limestone Analyses.....	381
Indicated H. P. Developed by Cheat River.....	415
Indicated H. P. Developed by Tributaries of Cheat River.....	416
Intervals from Upper Freeport Coal.....	58
Intervals to Oil & Gas Sands.....	198
List of Fossils in the Corinth Basin.....	483
Md.-W. Va. Boundary—Horizontal Distances, etc., No. 1.....	19-22
Md.-W. Va. Boundary—Magnetic Bearings, No. 2.....	22
Maximum, Minimum & Average Composition of Clays.....	378
Oil & Gas Horizons in W. Va.....	197
Order of Counties in Production of Coal.....	217
Origin of Various Soil Types.....	443

Tables Showing:	Page
Population, Districts and Towns.....	43
Population, Villages.....	43
Post-Offices.....	34
Production of Coal by Mines.....	218
Property Valuations.....	33
Register of Localities, Fossil Collections.....	485-7
Stream Data.....	47-8
Stratigraphic Distribution of Marine Fossils in the Cone-maugh Series.....	479-481
Summarized Record of Tests for Coal.....	220-221
Summarized Record of Tests for Oil.....	200
Thickness of Stratified Rocks.....	105
Tanner, Nathan, No. 1 Well (102A).....	200, 214-215
Taylor, M. H., Core Test 13 (39).....	220-231
Teets, Jerry, Monument.....	17, 22
Teets, M. L.....	384
Teets Monument.....	15, 21
Temperature, Grafton, Morgantown & Parsons.....	431
Temperature, Terra Alta.....	426, 431
Terms, Description of Geological.....	55-6
Terra Alta Cross Section B-B'.....	72
Terra Alta, Description.....	36-9
Terra Alta, Killing Frosts at.....	431
Terra Alta Lime Co., Limestone Quarry.....	381, 384
Terra Alta, Population.....	32
Terra Alta, Precipitation.....	430
Terra Alta, Temperature.....	426, 431
Terraces, River, Description of.....	54
Tests for Oil, Summarized.....	200
Thirty-Foot Sand.....	190
Thomas, Ira, Mine.....	133
Thomas Ridge Monument.....	18, 22
Thomas, Scott, Limestone.....	156
Thornton Fire Clay.....	147-8, 373-4
Threefork Creek Section.....	89
Tichenal, Steven, No. 1 Well (34).....	200, 205
Tichenal, Steven, No. 1 Well (35).....	200, 205-6
Tidal Elevations, R. R. Stations.....	470-1
Timber, Original Conditions.....	422
Tionesta Coal.....	178
Topographic Features.....	52-4
Towns and Industries, Description of.....	34-43
Towns, Population of.....	32
Trails, Indian.....	28-9
Transportation.....	25-31
Transported Clays.....	371
Transverse Tests, SS.....	397, 400
Trowbridge Section.....	93
Tuberculosis Sanitarium, State.....	37-8
Tuberculosis Sanitarium, State, Mine.....	182
Tunnelton & Ices Ferry Turnpike.....	30
Tunnelton, Description of.....	40-1
Tunnelton, Kingwood & Fairchance R. R.....	27
Tunnelton (Kingwood) Tunnel Section.....	153
Tunnelton Mine 53.....	306, 366, 369
Tunnelton, Population.....	32
Turnpikes.....	29-31

U

	Page
Uffington Shale.....	149-150
Unconformities.....	73-4
Unconformity, Definition of.....	56
Union District:	
Area.....	31
Clarion Coal.....	357, 363
Detailed Coal Tests.....	258-260
Greenbrier Limestone.....	384
Lower Kittanning Coal.....	346, 348, 363
Minable Coals.....	363
Oil Tests.....	200
Population.....	32
Prospective Oil & Gas Areas.....	215
Quakertown Coal.....	363
Upper Freeport Coal.....	309-10, 311
Upper Kittanning Coal.....	323-4
Well Records.....	214-5
U. S. Dept. of Agriculture, Weather Bureau.....	426-8
U. S. Geological Survey.....	397, 400, 471
Upper Ames Limestone.....	125
Upper Carboniferous Rocks.....	76
Upper Connoquenessing Sandstone.....	180-1, 402-3
Upper Freeport Coal.....	153-4
"Key" Rock, Table of Intervals from.....	58
Minable.....	198, 268-311
Quantity Available.....	311, 360
Upper Freeport Limestone.....	155-9, 370
Upper Freeport Sandstone.....	159
Upper Kittanning Coal.....	170, 312-324
Quantity Available.....	323-4, 360
Upper Kittanning Fire Clay.....	171, 374
Upper Mahoning Sandstone.....	147-8
Upper Mercer Coal.....	179
Upper Pittsburgh Limestone.....	118
Upper Pittsburgh Sandstone.....	107
Upper Youghiogheny Syncline.....	70-1
Upshur Clay.....	441, 443, 457-9, 469
Upshur Silt Loam.....	441, 443, 454-457
Upshur Silty Clay Loam.....	441, 443, 459-61, 468

V

Valley District:	
Area.....	31
Bakerstown Coal.....	134-5, 361
Clarion Coal.....	353-4, 361
Coal Tests, Detailed.....	228-239
Coal Tests, Summarized.....	220-221
Greenbrier Limestone.....	381-2
Harlem Coal.....	361
Lower Freeport Coal.....	361
Lower Kittanning Coal.....	329-31, 348, 361
Minable Coals.....	361
Oil Tests.....	200
Population.....	32
Prospective Oil & Gas Areas.....	207
Sections.....	86-88
Upper Freeport Coal.....	283-292, 311, 361
Upper Kittanning Coal.....	317-8, 324, 361
Well Records.....	206-7
Valley Furnace.....	405-6, 411-2
Valuation, Property.....	33

	Page
Vanport (Feriferous) Limestone	175
Villages	42-3
Virginia-Maryland Coal Corporation	89
Mine 44	295, 365, 369
Mine 70	334, 367, 370
Well No. 1 (67)	91, 200, 208
Volyard, S. H., Mine 43	293, 365, 369
Vulcan Mine 45	295, 365, 369

W

Walls A. F., Mine 15	273, 364, 368
Warfield Sand & Stone Co.	401-2
War-Path, Great	28
Washington and the West	422
Water Power Resources	412-418
Water Ways	25-26
Waters, Mineral	418-422
Watson, Sanford, No. 2 Core Test (42)	220, 232
Watson, W. A., No. 1 Well (97)	200, 210
Weather Bureau, U. S., Tables	426-8
Well Records (Oil & Gas) and Prospective Areas	199-215
Well Records by Nos.:	
1, 2, 3 (Grant)	200, 202
20 (Pleasant)	200, 204
34 (Pleasant)	200, 205
35 (Pleasant)	200, 205-6
46 (Valley)	200, 206
62 (Lyon)	200, 207
67 (Lyon)	91, 200, 208
69 (Lyon)	200, 208
86 (Garrett Co., Md.)	206, 212
90, 97, 99, 100 (Reno)	200, 210
101 (Reno)	200, 211
102 (Union)	200
102A (Union)	200, 214
102B (Union)	200, 215
Welton, Isaac, No. 1 Well (46)	200, 206
Welton, Wm., No. 19, Core Test (47)	220, 235
West Milford Coal	124

	Page
W. Va. Development Co.	220, 222, 223
Core Test No. 1 (7)	220
Core Test No. 2 (6)	220
Core Test No. 3 (16)	220
Core Test No. 4 (17)	220, 222
Core Test No. 5 (18)	220, 223
Core Test No. 6 (19)	220, 223
W. Va. Experiment Station	434, 463
W. Va.-Md. Boundary Dispute	1-24
W. Va. Northern R. R.	27
W. Va. Pottery Co.	376
Whetsell, B. P., Core Test 80	221
Whetsell, John O., Core Test 81	221
White, I. C., 54, 72, 108, 110, 112, 117, 118, 119, 124, 132, 133, 142, 143, 144, 147, 148, 149, 151, 408	
White, Mine 65	329, 366, 369
White Monument	13, 20
White Rock Sand Co.	180, 402-403
Wiley, S. T.	24, 25, 26, 28, 29, 35, 36, 39, 40, 41, 405-6
Wilhelm, Abraham, Limestone	381
Wills, John, Mine 77	343, 367, 370
Wilson, Edwin K., Core Test 33	220
Wilson, No. 3 Core Test (104)	221, 259
Wolf et al.	200
Wolf, J. G.	200, 210
Wolf, Jonas, Core Test 98	221
Wolf Mine (Nazareth Creek)	336-9
Wolf, W. M., Core Test 4	220
Wolfe, John A.	156
Wolfe, M. A., No. 1 Well (20)	200, 204, 325
Wotring, Fred, No. 1 Core Test (103)	221, 259
Wyatt, A. L.	202

Y

Yield of Principal Crops	436
--------------------------	-----

Z

Zevely & Casto	392
Zimmerman, Mr.	220
Zinn, Daniel, Core Test 58	221

